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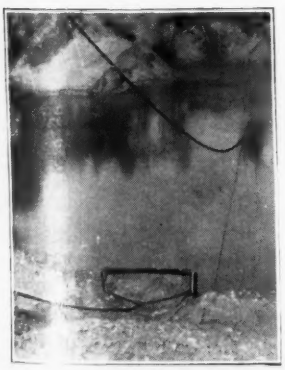

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November 15, 1924

Index to Advertisers - - Page 21
Table of Contents - - - - Page 23

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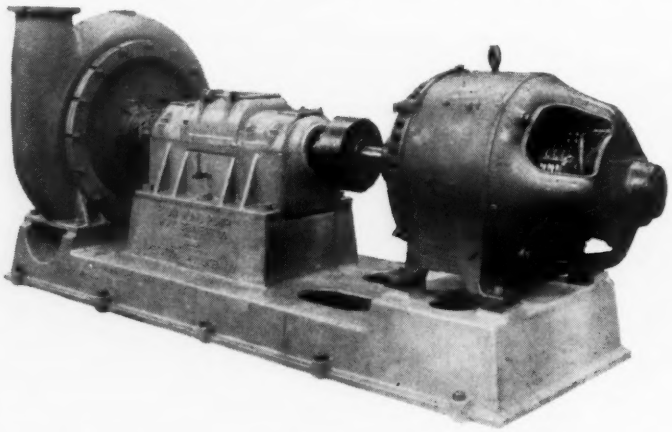

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Pit and Quarry

A Semi-Monthly Publication for Producers and Manufacturers of Sand, Gravel, Stone, Cement, Gypsum, Lime and Other Non-Metallic Minerals.

VOL. 9 CHICAGO, ILL., NOVEMBER 15, 1924 NO. 4

CONTENTS

Duplicate Units of Machines 25
Profits and Maintenance..... 26
Need for Reliable Cost Data..... 26
New Cement Plant with Unusual Features..... 27
Fire Prevention and Insurance Rates..... 41
Illinois Leads in Road Building..... 44
Stony Creek Gravel Company Operating New Plant.... 45
Winter Precautions for Your Truck..... 50
Fuel Conservation in Cement Mill Operation..... 51
New Incorporations..... 53
The News at Washington..... 54
Ward Sand and Gravel Company Producing 200 Cars.. 55
Plant Depreciation..... 61
American Road Show Notes.....67
Census of Lime Manufacturers..... 68
New Economical Sand and Gravel Plant..... 69
The Economics of Rate Making..... 77
Hazelton Stone and Sand Company Reducing Sandstone 89
Lime and Cement Man Elected to Congress..... 94
Calcined Dolomite in the Recovery of Gold and Silver.. 95
The Berkshire Gravel Company's New Plant..... 99
Annual Meeting of the Highway Research Board.....104
Cost Accounting in the Crushed Stone Industry.....105
Draft for Your Boilers.....111
Great Activity in Texas.....115
Trade Notes, Catalogs, New Equipment.....104, 116-119

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Publishers of
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HAROLD W. MUNDAY
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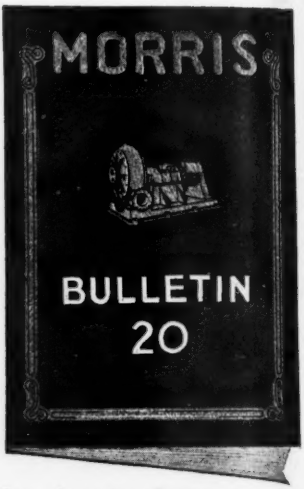
ROBERT N. RISSER
GEORGE B. MASSEY

If you produce sand and gravel

don't build any new plants or overhaul old ones until you have read this bulletin:



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With Morris Dredges, Sand Suckers, Conveying Pumps and Boosters—whichever the conditions demand—you can put a steady flow of accurately graded material onto trucks, scows or cars without any intermediate handling between the start and the finish. Further, your labor problems take on an entirely different complexion, because fewer men are needed and even those are not dependent upon brute force to earn their living.

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Pit and Quarry

Vol. 9 Chicago, Ill., November 1, 1924 No. 4

Duplicate Units of Machines

CONTINUOUS operation of a plant can be assured only by having duplicate units of every machine that is used. Without this duplication a breakdown necessitates shutting down the plant to make repairs. It is nonsense to suggest that a duplicate plant be installed and then be kept standing idle to cover an emergency such as a breakdown. This would be too much of an overhead for any operator and in the end would prove disastrous. However, there are some features of the plant equipment that can be duplicated to advantage.

When an operator has a ready market for all he can produce, a plant shutdown will not only reduce his income and profits but it will at the same time cause extra expense. Continuous production at the plant capacity is desirable. If the production cannot be maintained at the capacity of the plant, it should at least be continuous.

In a sand and gravel plant with a single screening and washing unit or in a stone quarry with a single crusher, duplicate units generally would be out of the question. The increased overhead would be too great for the production. In such a case it is advantageous to keep a supply of spare parts on hand for quick repairs to each machine. A repair shop equipped with the tools for making the necessary repairs quickly should also be maintained.

The question of duplicate units should be considered in the designing and building of the plant. Two smaller washing units may be installed in place of one large unit. Thus more material might be produced when necessary, and in case of an accident to one unit the other can continue production. When a series of conveyors is in use, the arrangement of the feed conveyors should be such that in the event of the breakdown of one crusher, it will be possible to cut out this crusher until it is repaired. The rest of the plant can then go on with production. When production is dependent upon a main unit, such as a pump, duplication as far as the pump is concerned is absolutely essential. If one fair sized boiler is sufficient to operate a plant, it may be poor economy to install a duplicate boiler. Yet if the load at times is excessive and a second boiler could be occasionally used, two units would probably be good economy as the second could be held for emergencies when not needed. There are many excellent examples of plants where the single units of the plant are so arranged that it is possible to cut out a unit in case of an emergency. Other plants having a large production, find it necessary to carry duplicate units to protect their market. Usually in such cases the production is so large that the duplicate units do not add appreciably to the operating costs.

Labor is an item to be considered in this question of duplicate units. Generally with the smaller plants duplicate units may require an additional man or two. Power is another factor. Where the production is quite large these two items are of little consequence.

The duplication of all essential units is desirable if it does not make the cost excessive. Operating costs, including power and labor, and capital investment are the main factors to consider. Continuous production is desirable, but money should not be invested in equipment that will be idle the greater portion of the producing season.

Profits and Maintenance

THE non-metallic industry presents an extremely diversified picture. The thousands of plants in this country illustrate almost every conceivable condition of management. The conditions vary from model efficient plants to those without any concern for costs, efficiency, methods or production. There is one objective common to all of these plants, however,—to produce a product at a salable price and a profitable cost. One of the important factors in accomplishing this objective has been neglected in many plants. This factor is maintenance.

Many plant operators whose minds are centered upon the primary purpose of production overlook or fail to realize the close relationship between production, profits and maintenance. The proper maintenance of plant and equipment in the non-metallic industry is more important today than it has ever been in the past. Competition today necessitates maintaining the highest continuous production possible.

Maintenance has two important functions. The first is to ensure continuous production at the maximum. The second is to protect the investment in machinery. These two functions form a most important reason for a close and thorough study of maintenance by all plant operators.

Many plant operators fix their attention so closely on production that maintenance is entirely neglected. It has taken a plant breakdown to bring the question of maintenance to their attention. Concentration on production is admirable and effective provided there is also concentration on maintenance. Both are essential for securing maximum production.

The operator should concentrate on maintenance as well as on production. He should prevent shutdowns rather than remedy them. He should protect machinery rather than replace it.

Need for Reliable Cost Data

COMPETITION is becoming keener each year and is making it essential that all problems pertinent to production be studied carefully. In order to produce and sell profitably operators should pay strict attention to their costs. An adequate cost accounting system is essential to every business enterprise. This fact is being recognized widely by executives who are seeking methods that will enable them to ascertain their costs accurately and scientifically. Such procedure will result in more stable business conditions by eliminating risk.

A fairly large proportion of the cost of a product consists of elements which cannot be weighed, measured or counted. Such elements are accounted for in a cost system. To fail to account for them involves an unnecessary and dangerous risk. When there is no cost system, the records are invariably inadequate and unreliable.

To install a suitable cost system requires ability and judgment. The adoption of the best possible cost system is a matter of economy. The best is the cheapest in the end. The best is not necessarily the most complicated; it does not consist merely of a collection of forms. The essential need is that it shall be suitable to the type of business for which it is intended. Its purpose is to establish and record relative costs thus enabling the executive to make necessary adjustments immediately. The efficiency of the cost system is largely dependent upon the briefness of the period during which the data is collected. The tendency at the present time is toward simplified cost systems especially in small plants. The principal need is to record the determinable cost elements and to adopt rules for apportioning all items in order to secure accurate information.

It is often difficult to determine just what data is to be compiled into a cost system, and the tendency is to use an excess amount. Of course, when a producer deals with a great variety of products or uses a great number of operations, the details necessary for the cost system are more numerous and complex than they would be under a simpler process. A competent cost accountant can usually handle cost systems for different lines of industry even when the fundamentals are essentially different. The basic principles are uniform and easily adaptable. There are, however, specialists in various fields whose services are of greater value because of their wide knowledge of specific problems which confront producers.

New Wet Process Cement Plant With Unusual Features

Peerless Portland Cement Company Completing Detroit Plant. Plant Fitted to Limited Area and Peculiar Shaped Property

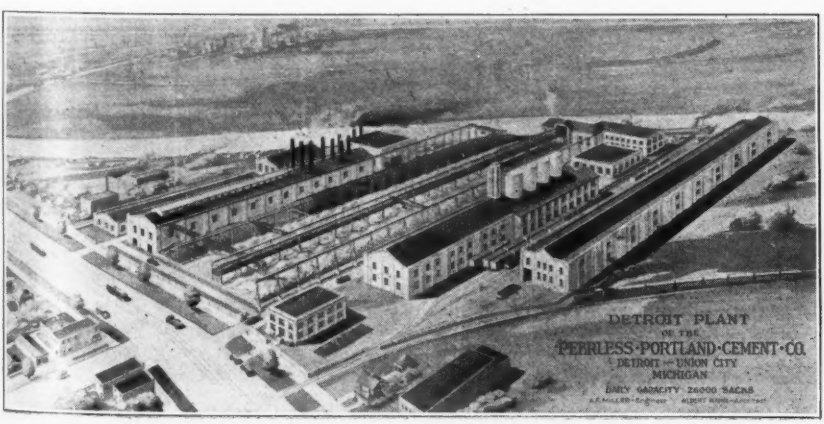
THE Peerless Portland Cement Company has been an important factor in the development of the Portland Cement industry in the United States and especially so in the State of Michigan. This company constructed and operated the first successful Portland cement plant in Michigan at Union City in 1897. This plant is still in operation. The methods of manufacture first adopted afford a remarkable contrast to the methods employed at Union City today and an even more marked contrast to the methods to be employed at the new plant at Detroit. The capacity of the plant at Union City has been increased from 500 barrels daily to 2,100 barrels.

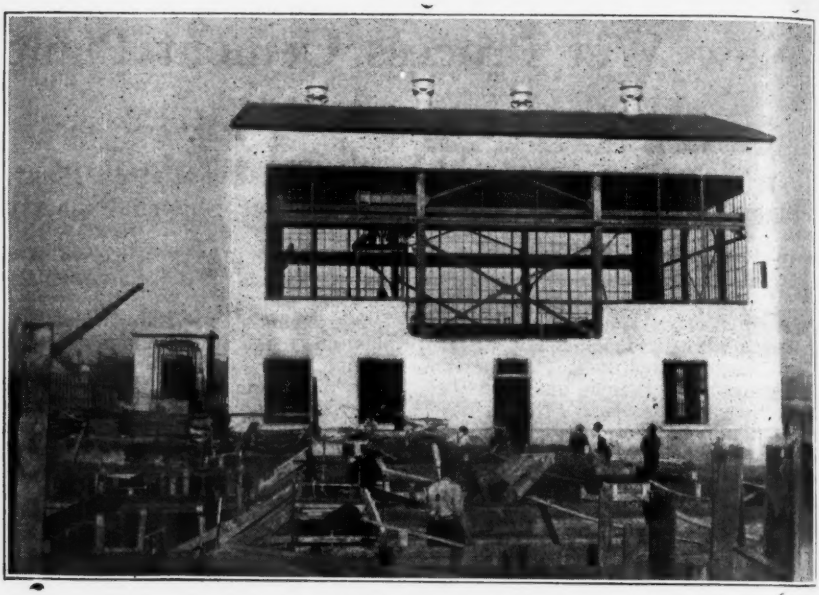
The old style German vertical kilns were used at the start of the Union City plant. Marl and clay were mixed and made into bricks. These bricks were dried in ovens and then placed with alternate layers of coke in the vertical kilns. The material came through the firing process and out the lower end of the kiln as clinker. This clinker was then crushed and ground into finished Portland cement. Contrast these methods with the methods of today. The improvements made in the Union City plant during the last twenty-seven years are representative of the progress made in the manufacture of Portland cement.

The remarkable improvements in machinery and the economies of operation introduced into the industry have been somewhat offset by the increasing transportation costs, so the consumer has not had the full benefit. The recent tendency to overcome this transportation problem has been to locate the plant as near the center of distribution as possible and still be close to the necessary raw material.

The new Detroit plant of the Peerless Portland Cement Company is an outstanding example of this movement to locate near the center of the market. This is the most recent of the Michigan cement plants and also represents the most improved type. The plant is located on a triangular tract of land consisting of fourteen acres on the River Rouge, about five miles from the heart of Detroit. About ninety per cent of the market that will be served by this plant is in and close to Detroit.

The plant is located on a main street and is adjacent to the Michigan Central Railroad tracks. Shipments can be made by rail, water or truck. The company expects to han-

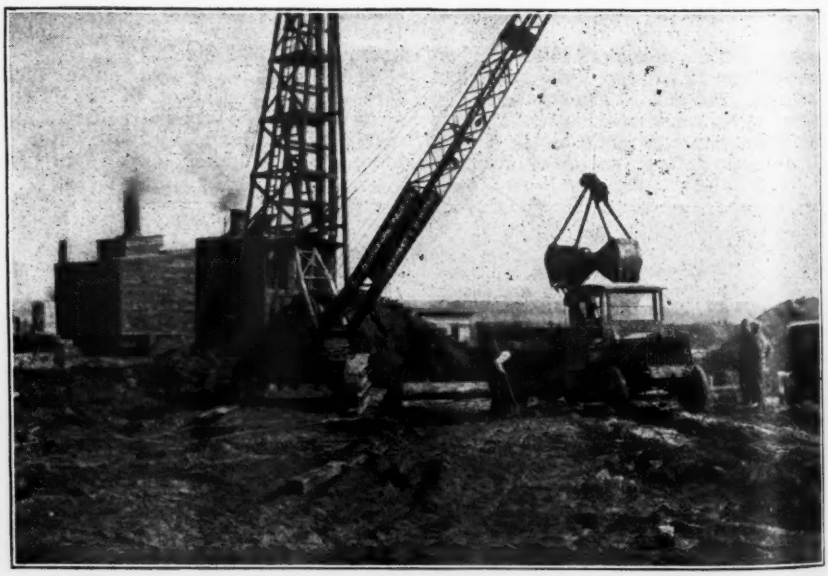




The Waste Heat Power House.

dle about ninety per cent of its output by truck. Due to the congested condition of the streets of Detroit the trucks will deliver during the night. If necessary, however, truck deliveries can be made during the day. The boats and railroad cars will be loaded during the day. The plant at Union City will handle the bulk of the railroad shipments.

An 862 foot concrete dock has been constructed to accommodate large boats. It was necessary to dredge the river and to straighten the bank in



Dredging Operations Are Practically Completed.

order to eliminate the possibility of blocking river traffic. As the bank stood, the boats would have had to set out at a considerable angle and possibly tie up other boats in passing. Harbor regulations do not permit blocking river traffic. While the Peerless Portland Cement Company was forced to straighten out the bank, it will result in many economies even though a half acre of ground was lost. The boats can now come in alongside the dock and be unloaded much more rapidly and without danger of penalty from tying up other traffic. Limestone will be shipped in by water from the quarries at Rogers City, Michigan. Clay will be shipped in from Wayne, sixteen miles west of Detroit, over the Michigan Central Railroad. The caustic waste from the Solvay Process Company's alkali plant will be used also.

This waste is in the form of precipitated calcium carbonate and will be delivered direct to the storage tank at the cement plant by pipeline from the Solvay plant in the form of a slurry, containing 75 per cent water and 25 per cent solid. This material will then be drawn in a fixed quantity from storage and delivered to the wash mill and added to the clay drawn from the clay storage. The excess percentage of water in the Solvay waste will thus be utilized, and any additional water necessary will be added in the usual manner. The mixture of clay and Solvay waste will then be pumped to the raw compartment mills meeting the limestone coming from the limestone storage. The Solvay waste will be stored in a rectangular shaped concrete storage tank 110 feet long, 25 feet wide, and 22 feet deep. This tank will accommodate several days' supply of Solvay waste. The waste will be agitated by a Smidth traveling agitator.

The limestone will be shipped in by water from the quarries at Rogers City and unloaded at the dock and placed in a storage hopper. From the hopper the stone will be carried by a 54 inch belt conveyor to storage in the heart of the plant. This central storage space is 550 feet long and 172 feet wide. The belt conveyor will run the full length and down the center of this storage. This conveyor belt will be driven by a 200 H.P. variable motor at a speed of 600 feet per minute if necessary. This will make it possible to unload a 10,000 ton car in four hours. On either side of this storage will be an 80 foot Whiting overhead electric traveling crane equipped with a 3 yard clamshell bucket. As the stone will not need to be crushed, the cranes will deliver direct from storage to the raw grind-

Another Construction View Taken October 16, 1924.

ing departments. With this arrangement it will be possible to store 150,000 tons of stone.

Adjoining and parallel to the stone storage will be the clinker and coal storage. This storage space will be the same length as the stone storage but 80 feet wide. Half of this area will be utilized for clinker storage and the other half for coal storage. The normal clinker storage will accommodate more than 10,000 barrels of clinker. The coal storage will be normally 17,500 tons. This arrangement is flexible as the stone storage can be utilized for clinker storage and the clinker storage for stone as the occasion arises. This combined storage will be a problem of balance. One Whiting crane will operate the full length of the coal and clinker storage and handle both the coal and clinker.

The demand for cement in the Detroit area is seasonal. During the dull period the clinker storage will be at its maximum and it may be necessary to utilize some of the stone storage area for clinker storage. During the heavy demand period it may be necessary to use some of the clinker storage area for stone storage. During the period of closed navigation when it is not practical to receive stone by water, the stone storage will be utilized for clinker storage. The clinker storage of 100,000 tons will be sufficient for normal production, however. A cross conveyor will be utilized in moving the clinker storage to the stone storage area. Assuming that the stone storage area was entirely filled with clinker, it would be possible then to store 700,000 barrels of clinker.

The clay storage is entirely removed from the other storage area. A structural steel and concrete building 80x250 feet is being erected for this purpose. A capacity of approximately 15,000 tons will be provided for at first. Eventually this storage capacity will be increased to 30,000 tons. Railroad cars will be moved into this building and unloaded by a Whiting overhead electric crane of the same type and capacity as those used in the stone and clinker storage.

The Peerless Portland Cement Company plans to eliminate 12 hour shifts and the 7 day week wherever possible. The kilns and power house are all that will be operated seven days a week. Both these departments will be operated with three shifts of eight hours each and seven days a week. Relief operators will be used so that each operator has one day off each week. The other departments will be operated six days a week with no shift exceeding ten hours. The raw grinding department

A View During Construction of the Coal Mill.

schedule will be so arranged that sufficient material can be prepared in six days of twenty hours each to keep the kilns going seven days at twenty-four hours each.

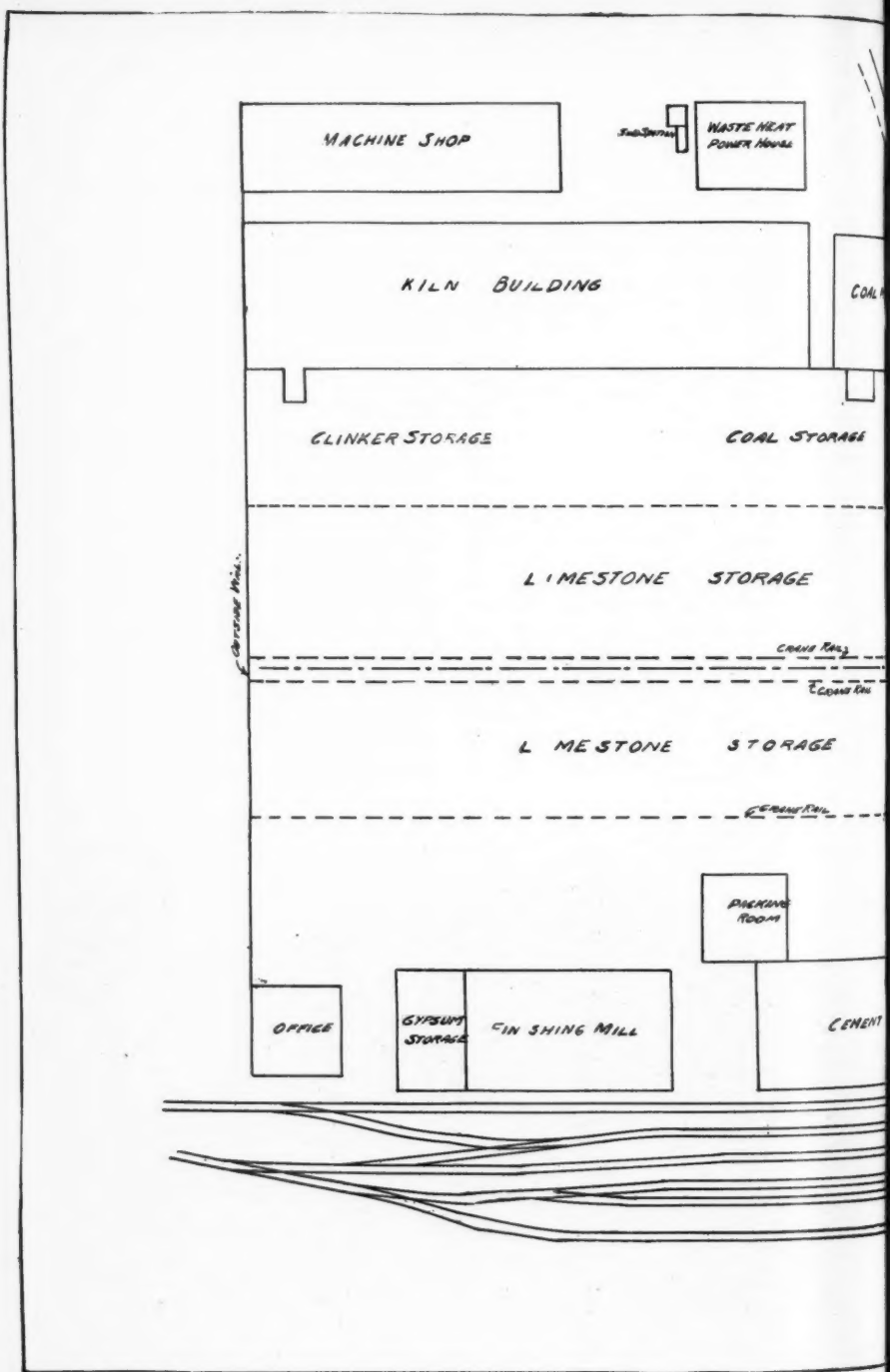
Since the property was adjacent to the River Rouge, it was found desirable to drive piles down 80 feet to rock under all machinery foundations, retaining walls and buildings. Such construction affords surety against settlement and misalignment of buildings and foundations. The design also provides an elaborate system of strutting and bracing to prevent lateral movement of any of the foundations.

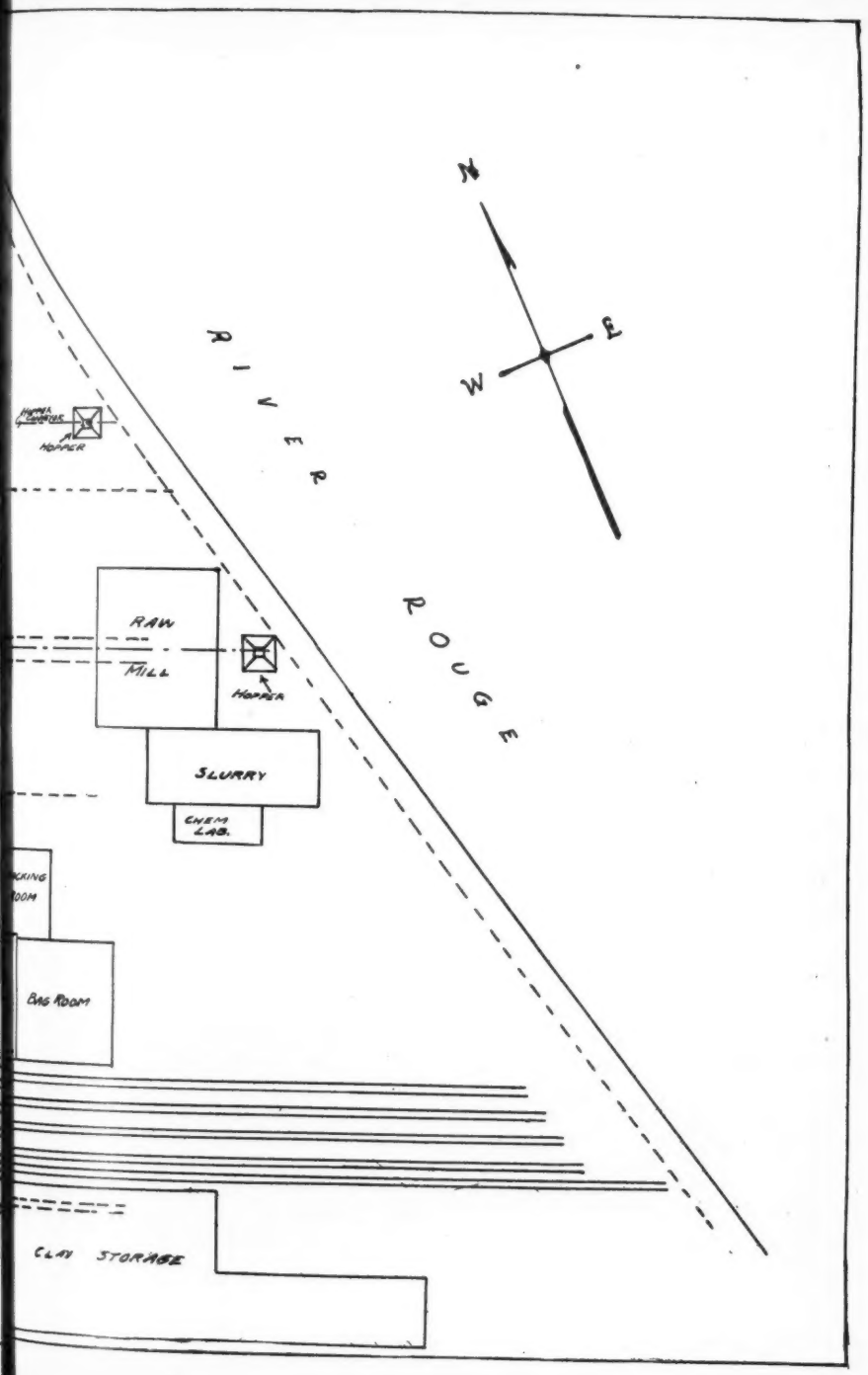
Owing to the peculiar shape of the property and the limited area available and the necessity of providing very large storages, the problem presented was to fit the buildings to the property and still have ease of operation. Each building is a unit in itself. All the buildings have their own complete sanitation features. The framework is all steel. The roofs are of cement tile. Steel window sash, copper sheet metal cornices, etc., are other features. All corners and entrances to large doorways are protected by concrete abutments. Even the doors are to be equipped with kick plates and wearing strips. All sash ventilation will be mechanically operated. The buildings will be steam heated throughout. The Detroit Building code governs the construction and safety features of all buildings.

The clay mixing tanks will be at one end of the clay storage building. The clay slurry will be pumped from these tanks by a 3 inch vertical pump to the large mixing tanks near the raw grinding mills. Three 7x26 feet Traylor compartment mills driven by 500 H.P. Ridgway synchronous motors will do the raw grinding. The Ridgway motors are equipped with 60 inch Cutler Hammer magnetic clutches. From these mills the material will be pumped by a 6 inch horizontal pump to the mixing tanks.

From the mixing tanks the slurry will move by gravity to a correcting basin, and from this basin it will be pumped to three large storage tanks under the kilns by a 6 inch vertical pump. The slurry will then be pumped from these storage tanks by a 5 inch pump into a rectangular troughed bottom steel tank mounted over the feed end of the kilns. Nozzles will be used to regulate the feed into the kilns. The feed will be regulated by simply changing nozzles. There will be 12 different sizes of nozzles, and the selection of the correct size will depend upon the condition of the slurry. All the pumps used in the handling of the slurry will be furnished by Morris Machine Works. There will be two pumps at

A View of the Three Kilns.


MACHINE SHOP
WASTE HEAT POWER HOUSE
KILN BUILDING
CLINKER STORAGE
COAL STORAGE
LIMESTONE STORAGE
CRANE RAIL
LIMESTONE STORAGE
PACKING ROOM
OFFICE
GYPSUM STORAGE
FINISHING MILL
CEMENT


N
E
W
RIVER ROUGE
HOPPER
RAW MILL
HOPPER
SLURRY
CHEM. LAB.
BAG ROOM
CLAY STORAGE

each pumping point. One of these pumps will be used as an auxiliary.

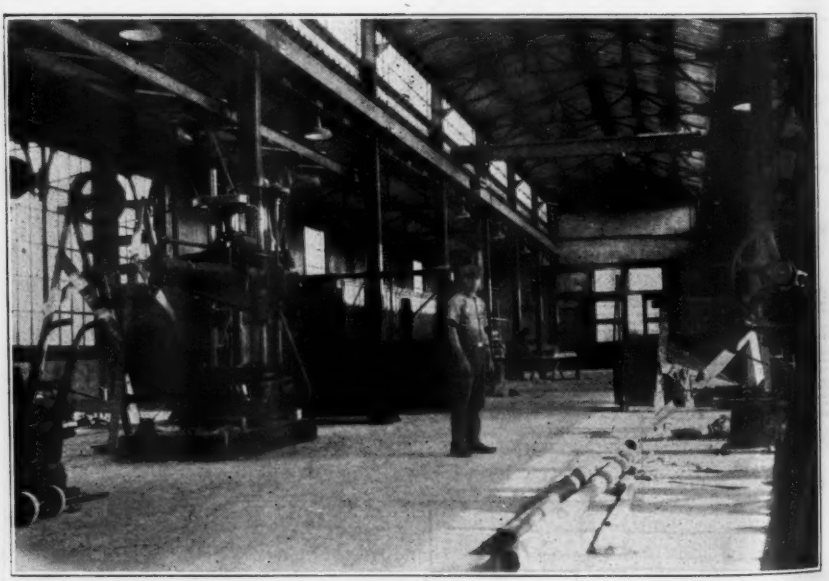
Three Traylor kilns each 175 feet long, with a diameter of 11 feet through their entire length have been installed. These kilns will be driven by 100 H.P. motors and fired by pulverized coal. The coal will be pulverized by two of the largest Raymond "Super" mills equipped with the latest type of dust collecting equipment. The coal will be dried in two type A-10 Ruggles Coles dryers. The coal will be transported to the pulverized storage bins over the kilns by two 8 inch Fuller Kinyon pumps. The coal dryers will be equipped with Cyclone dust collectors and so arranged that centrifugal washers can be installed later if desirable.

The finish grinding will be handled by three 8x26 foot Traylor compartment mills each driven by a 650 H.P. Ridgway synchronous motor equipped with a 66 inch Cutler Hammer magnetic clutch. Foundations have been installed for a fourth mill should this additional mill be needed. The finish mills of a larger size were selected to prepare for any unusual demand for finished cement. The finish grind department has a capacity of 9,000 barrels per day. This will include the 4,500 barrels a day from the kilns and an additional 4,500 barrels from clinker storage.

The finished cement will be delivered by spiral conveyors and tightly encased elevators to the cement storage tanks. There are eight concrete silo cement storage tanks with a combined storage capacity of 200,000 barrels. These storage tanks are being built by the MacDonald Engineering Company. From storage the cement will be drawn by underground conveyors and delivered to either of two packing houses. One of these packing houses will have four Bates packing machines and the other three. These seven Bates machines will have a combined capacity of 1,000 barrels an hour allowing 10 minutes for the loading of each motor truck.

The packing machines will be on the second floor, and an open driveway under each packing machine will make possible the loading of seven trucks simultaneously. The driveways all through the plant will be of concrete. The trucks will come into the packing houses by one driveway and leave by another, thus preventing congestion. The packing room, warehouse, and sacking department will be equipped with a Sly dust collecting system.

Three waste heat boilers of 100 H.P. each of the vertical type have been installed. Each of these boilers has 10,000 square feet of heating sur-



An Interior of the Machine Shop.

THE AMERICAN NATIONAL RED CROSS holds its annual nation-wide ROLL CALL from Armistice Day, November 11th, through Thanksgiving Day, November 27th. In this period it seeks to re-enlist its present membership and to enroll new members for 1925. The Red Cross "makes its appeal for support directly to the conscience of mankind." Every one is invited to join through the local Chapter or Branch.

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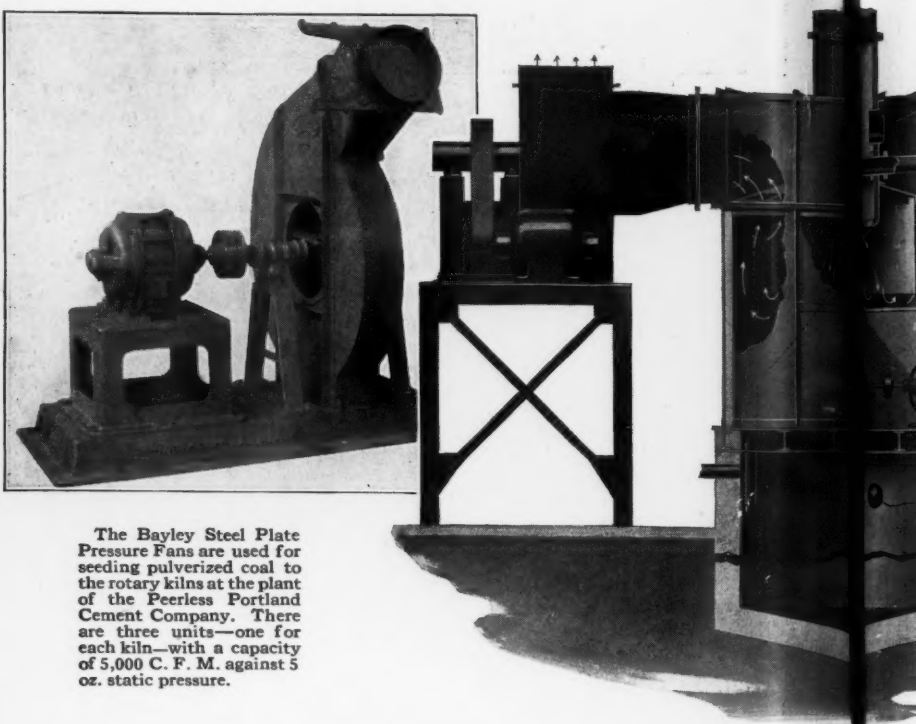


The Bayley Steel Plate Pressure Fans are used for seeding pulverized coal to the rotary kilns at the plant of the Peerless Portland Cement Company. There are three units—one for each kiln—with a capacity of 5,000 C. F. M. against 5 oz. static pressure.

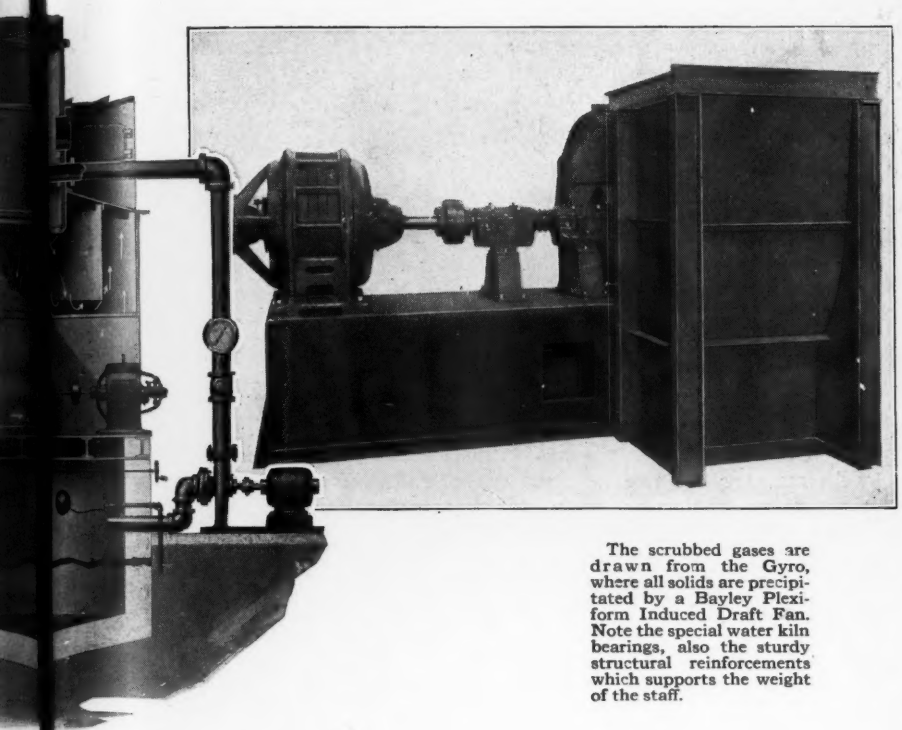
ECONOMY AT

The Bayley Gyro Scrubber reclaims more than 98% of all raw rock and fi clinkers that, with less modern methods ,was formerly wasted through the kiln sta and not only is there great economy in reclaiming thousands of tons of valua material each year, but a nuisance need no longer be committed by spreading a fi dust over the adjacent territory.

Three units, each handling 90,000 C. F. M. of kiln gas at 1100° F., make a savi that represents a handsome return on the investment. The rock laden gas fro each kiln enters the refractory lined intake of the Gyro and passes downward throu

BAYLEY MANUFACTURING CO.

Bayley



The scrubbed gases are drawn from the Gyro, where all solids are precipitated by a Bayley Plexiform Induced Draft Fan. Note the special water kiln bearings, also the sturdy structural reinforcements which supports the weight of the staff.

AT LESS PORTLAND

and fu
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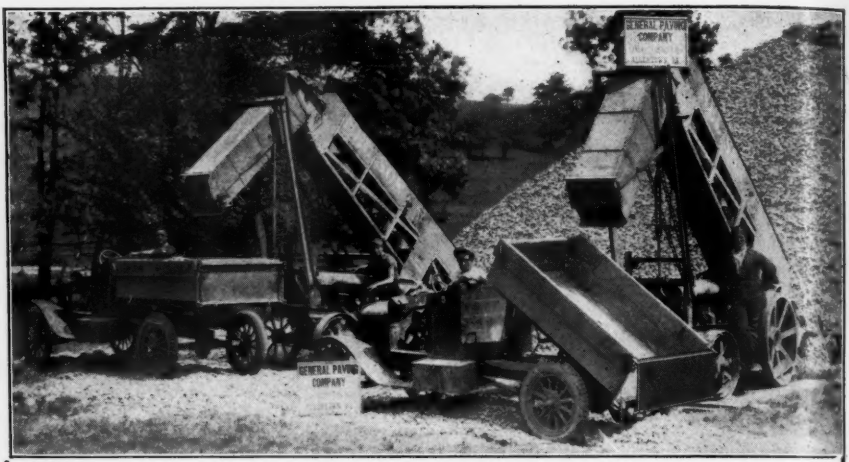
Gyro Duplex Wheel where it is mixed with water and thoroughly saturated by cutting or "kneading" action as it is thrown against the concentric rows of pins the Gyro Wheel.

The saturated particles pass off with the water to the sump pit where the terial is reclaimed and from which the water is used over and over again for fur- scrubbing. Our engineers will be glad to recommend similar equipment for the laiming of any kind of material or the abatement of any dust nusiance.

760 GREENBUSH ST., MILWAUKEE

Bayley



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are especially designed to make money for you. They are light and quick to get around with; will carry a maximum load even on bad roads; and have a low initial, operating, and maintenance cost.

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World's Largest Builder of Hydraulic Hoists and Steel Dump Bodies

7952 Riopelle Street **DETROIT, MICH.**

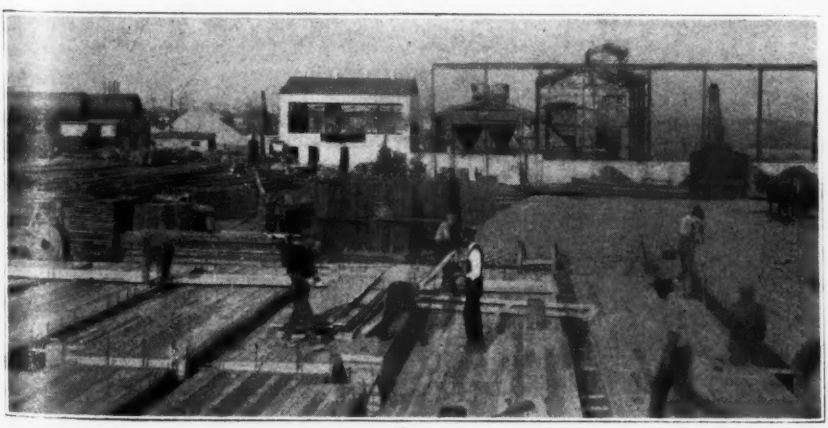
face. A 500 H.P. auxiliary boiler to be fired with pulverized coal has been installed for auxiliary purposes and for starting up the plant. These boilers were furnished by George T. Ladd Company. Three Sturtevant economizers have also been installed. There will be a waste heat unit to each kiln in place of the general method of a common flue. The dust will be converted back into the slurry and returned to the kilns in that form. The gases discharged from each waste heat unit will pass into a Bayley rotary scrubber and all dust removed. A Bayley induced draft fan will be located on the outlet of the scribber to draw the dust laden gases through the scrubber. There will be three of these scrubbers, or gyros as they are called, one for each waste heat boilers. Each of these scrubbers will handle 45,000 cubic feet of gas per minute at 400 degree temperature. This will be the wet sytem of collecting and delivering dust employing the centrifugal principle, and 1,200 gallons of water per minute will be used for each scrubber.

The gas enters the scrubber through a central refractory lined drum at the top and passes through a gyro wheel. This wheel is conical in shape and has concentric rows of pins. The water enters the cone of the wheel at low pressure and is thrown by the centrifugal force of the rapidly rotating wheel against and along the first set of pins. This is repeated against each successive row of pins, and the final set of pins throws the water with the solid matter against a splash plate which is hung at a little distance from the wheel. This scrubbing action thoroughly saturates each particle of dust with water.

These scrubbers were furnished by the Bayley Manufacturing Company of Milwaukee, Wisconsin. This concern also furnished the steel pressure blowers with a capacity of 5,000 cubic feet per minute at a pressure of 5 ounces for injecting the coal into the kiln. Each of these blowers is driven directly by a 15 H.P. motor. There will be a by pass flue going directly from the stack house to the scrubber and fitted with a water cooled damper which will be automatically controlled by steam pressure thus passing an excess of waste heat and preventing loss of heat through the safety valves.

The power plant will contain two 3,000 KVA Ridgway turbo alternating units generating at 2,300 volts. Two 150 KVA direct current units will be installed for supplying service about the plant and for the excitation of the four synchronous motors. Two Elliot surface condensers have been installed for use in connection with the turbo units. A 500 KW connection has been made with the Detroit Edison Company so that outside power will be available in case of an emergency. Motors above 20 H. P. will operate on 2,200 volts and those below will operate on 440 volts.

The design and ideas are due to Mr. A. F. Miller, consulting engineer of Jackson, Michigan. The details pertaining to the arrangement and construction were carried out under the direction of Mr. Miller at the Detroit offices of the Peerless Portland



A Distance View Showing Foundation Work.

Cement Company. Mr. Albert Kahn, architect of Detroit, collaborated in problems pertaining to foundations and buildings.

The piling and dredging are being handled by the Candler Dredge and Dock Company of Detroit. All the foundations and buildings, except the cement storage silos and packing house which are being built by the MacDonald Engineering Company of Chicago, are being erected by Henry L. Vander Horst, a general contractor of Kalamazoo. The roofs, walls, windows, etc., have been let as sub-contracts to local firms. The Peerless Portland Cement Company is installing all the machinery and power apparatus except that included in the MacDonald Engineering job.

The proposed plant as shown by the illustration at the beginning of this article will represent the finished plant with but slight modification. This plant will be demonstrative of what can be accomplished with a limited area of land and a peculiarly shaped property. The layout in reality represents the fitting of a cement plant to these conditions. When completed the plant will be one of the most improved types of cement plants in the world. The capacity will be 1,500,000 barrels a year.

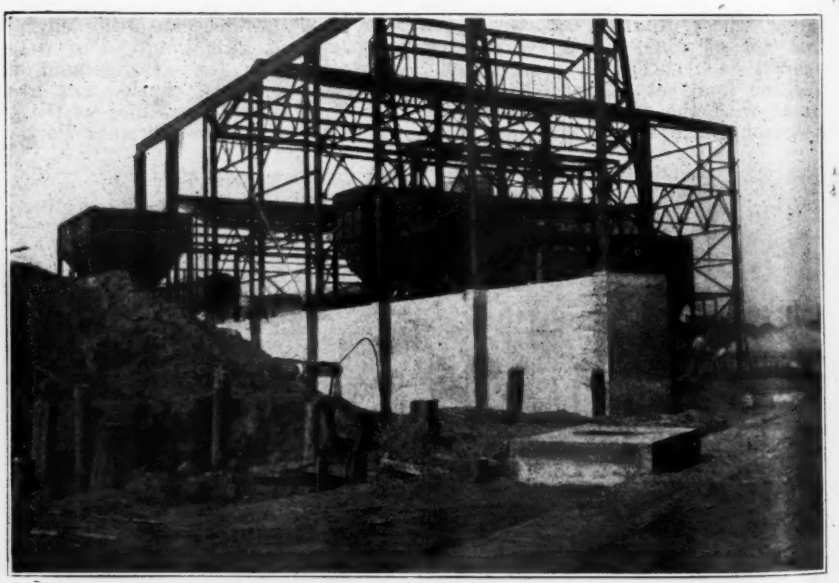
The officers of the Peerless Portland Cement Company are Mr. W. M. Hatch, President, Mr. C. S. Bush, Vice-president and Mr. John Gillespie, Secretary and Treasurer.

American Manganese Appoints T. B. H. Askin Sales Manager

The American Manganese Steel Company of Chicago Heights, Ill., announces the appointment of T. B. H. Askin, effective October 1st, as Sales Manager for the Intermountain Division, with headquarters at their Denver office.

Mr. Askin's previous sales and operating experiences includes five years in active mill operation with one of the largest Western mining companies. This, added to his thorough training in the manufacture of Manganese Steel Castings, has been more recently supplemented by several years successful experience in selling Manganese Steel and assisting his customers in applying it to numerous types of equipment.

This appointment the company believes is a step forward in its ability to serve the customers of its Denver plant. The co-operation of the public is requested with this organization which stands ready to serve at all times. Copy of the new catalogue may be had on request.



Another View of the Coal Mill.

Fire Prevention and Insurance Rates

Written Expressly for PIT AND QUARRY by DWIGHT INGRAM.*

OF the $500,000,000 annual loss from fires in the United States at least 75 per cent is due to carelessness. The sand, gravel and stone industries have no peculiar inherent hazards—no combustible merchandise and no inflammable processes like japanning. Ordinary boilers to heat buildings or furnish power are about the only furnaces. Therefore the losses in this business are less excusable than the general average, and the fire wastage is almost entirely preventable.

The study of fire loss involves two distinct but interrelated subjects. Of these two, fire prevention should be the more important. No calamity can be more disastrous than the wiping out of a plant over night. The year's profits are gone, customers may be lost to competitors, and insurance often furnishes only partial indemnity. The rules of safety ought to be practiced for their own sake.

In reality, however, business men need some prize or cash incentive to take care of their own property. Such a bonus is found in credits in the insurance rate, and the science of rating thus becomes an inseparable complement to fire prevention.

Rates are never made by guess any more, and only in the case of a few mutual or "wild cat" companies are they fixed by bargaining. The rate is the measure of the relative fire hazard of a given plant. A rate of one dollar (disregarding for the moment the overhead expense of insurance companies) means that the chance of loss from fire is exactly one per cent. A factory with a rate of one dollar also has just half the probability of fire loss which a plant with a two dollar rate has. Consequently when a property owner makes some improvement for the sake of fire prevention he is given a credit in his insurance rate, and the resulting reduction in premium will frequently amount to more than the cost of the improvement.

The machinery of rating and fire prevention has largely been turned over to a central bureau for each state. In most cases the bureau is maintained jointly by the insurance companies independently of political domination. The business of the bureau is to establish standards of safety, promote fire prevention, and make rates which shall not discriminate against any individual or any class of industry. The rates are made by sending an inspector to write a detailed report on each commercial building and then adding together the charges for all defects as shown in a comprehensive schedule.

Accompanying this article is a page illustrating the practical work of fire prevention and rating. Inspection reports are given for two typical buildings, one brick and one frame, with the appropriate schedule charges and credits. It is evident that each property owner really determines his own degree of safety and his own rate of insurance because he creates the physical conditions of the plant on which the rate is based. From the analysis one can see that any firm can reduce its own fire hazard and also save money on premiums. Such improvement can be made in four different fields, which will be dealt with in the following order:

1. Fire resistive building construction
2. Elimination of any unnecessary hazards of occupancy
3. Fire protection
4. Exposure to transmitted fire from nearby burning buildings.

(1) In the field of building construction it is obvious that brick walls or cement floors will retard the spread of fire better than wood. In many cases frame buildings are unavoidable because they are cheap or because they are temporary, but any plant with a permanent location within reasonable access to building materials will certainly save money in the long run by choosing a superior type of construction. While it is easy to understand that brick walls (especially for the boiler house) tend to isolate fire, there is another principle of construction that is less widely known. Fire goes up. It will spread sideways and even downwards to some extent, but its principal direction is upward. When fire occurs, therefore, skylights, stairways and elevator shafts become virtually flues. The draft they furnish is enough to fan

*Engineer, Morse, Case, Lyman and Hubbard.

a small fire into an uncontrollable blaze. The value of concrete floors is that they confine fire to the floor on which it starts. But since even wood floors retard fire a little, it is vitally important to have tile or brick stair and elevator shafts with automatic closing doors so that fire cannot use these avenues to spread its destruction.

Besides walls and floor openings the chief structural feature to watch is the flues and smokestacks. Every superintendent thinks that his arrangement is safe, and so it is under ordinary conditions. But to avoid fire a plant must be fool-proof, and the unexpected overheating or deterioration is bound to come some day where pipes are run through roof or frame wall, where brick chimneys are supported by wood brackets instead of being built solidly from the ground up, or where rubber hose is used for gas connections in place of flexible metal tubing.

(2) Ninety per cent of all fires are due to the occupancy rather than the construction of the building. Poor housekeeping and careless use of tools and equipment are a big cause of fire. While some neglect on the part of employes will always persist, most of this risk can be eliminated by the superintendent. Quite often an inspector finds a gasoline blow torch that was brought in for some repair job and then forgotten. It is a good rule to get rid of every torch or furnace that is not necessary to the conduct of the business, because every open flame is a potential invitation to carelessness.

The greatest contribution a superintendent can make toward fire prevention is to provide the simple, common safety devices. Oily rags and waste are going to be thrown into corners unless metal cans are close at hand. Wood lockers will spread fire if a workman puts in them over night a pair of overalls with oil or paint spots that can ignite spontaneously; if the overalls are kept in metal lockers with only small air holes they can burn up without damage to the factory. Enough metal boxes for rubbish and signs prohibiting smoking must also be provided. Then if the superintendent will enforce the use of these devices, set an example by using them himself, and penalize or even discharge the careless workmen, the risk of fire will be reduced to a negligible minimum.

(3) Fire prevention includes not only the elimination of causes but also adequate provision to detect and extinguish fire before it has got beyond control. To a large extent this work must be left to the municipal authorities, but producers located even in the heart of cities can do some things to help. The first step is to invite in the fire department chief and make sure that his officers are familiar with the lay-out of the plant so that they can reach the seat of fire quickly and do their work without damaging property unnecessarily. On the chief's advice a manufacturer can install fire hose and private hydrants, and train a volunteer brigade of employes to such efficiency that they can cope with a fairly large blaze.

The best protection, of course, is automatic sprinklers. Occasionally they fail through mechanical defect, but in ninety-nine cases out of a hundred sprinklers will certainly put out fire in its incipiency. The reason they are not more universally found is not any doubt as to their efficiency, but merely the large cash outlay required for their installation or sometimes the inconvenience of having to furnish heat for the water supply tank all winter. Generally speaking one must have at least $250,000 of insurance and be willing to keep a night watchman in order to have the saving in premium pay for the cost of installation. Peculiar conditions occasionally make a saving possible where less insurance is involved, and there are certainly many smaller plants where the owner should be willing to spend considerable money just to make more sure that his business will not be interrupted by fire.

Every fire at its start is no bigger than a waste basket. The fire hazard is minimized, therefore, if a system is worked out for prompt discovery and if first aid appliances are distributed throughout the plant. During the day the presence of workmen will take care of discovery, but at night it is necessary to have a watchman visiting every room in the plant hourly. It is also advisable to have the superintendent personally inspect the plant just after closing time. Most fires start during the first hour after shutting down, and the common causes are oily rags, cigarette stubs and matches tossed in corners by the departing workmen. All these would be detected by a careful inspec-

tion. First aid appliances include water barrels and buckets, sand pails, axes and three types of chemical extinguisher: soda and acid, carbon tetrachloride and foam. The two last named extinguish fire by smothering rather than by cooling and are the only kinds that can be safely used on oil, paint or electrical machinery. The principle of distributing these is to have one in every room or building, and in large sections of the plant make sure that a man will never have to run more than thirty-five feet for one. A chemical extinguisher will put out any incipient fire if it is found and used quickly.

(4) The final factor in fire hazard is exposure, or the chance of fire in an adjoining building being transmitted. A superintendent will often find that his watchfulness outside the operating plant is not as intelligent as inside. Rubbish or old lumber may accumulate in corners of the yard or nearby property. Such conditions are fire breeders. Or a plant may have three or four flimsy sheds where one good structure would be better. Beyond these immediate matters the exposure hazard should be seriously considered in a corporation's permanent building plans. The distance from railroad tracks or the provision of roofs that will not ignite from locomotive sparks, the space between buildings and the erection of enough brick division walls are points which some day may make the difference between a small fire and utter ruin.

All of the foregoing recommendations are nothing more than applied common sense, and any business man can devise safety rules for his own plant. But because fire prevention has become a science one may prefer to have technical guidance. The most skillful advice comes from the large insurance brokerage firms in New York and Chicago, which operate all over the country and employ engineering departments whose sole business is preventive work. If, however, your insurance is handled locally you can ask for the services of a special agent of one of the insurance companies; these men are not specialists, but have enough general information to be useful. In either case the instruction which the property owner gets is free. With such expert guidance and foremen willing to cooperate, a manufacturer can safeguard himself against the most sudden and complete of all calamities—fire.

ANALYSIS OF FIRE INSURANCE RATES FOR TYPICAL BUILDINGS

	Per cent	
*Basis, 2-story BRICK building under sixth class public fire protection		$ .37
Following charges for defects of construction and hazards of occupancy are percentages of the basis:		
Area, 4,000 sq. ft. per floor	8	
East wall deficient in thickness	4	
Elevator and stairway not in brick shaft	5	
Frame elevator head on roof	5	
Occupancy (stone crushing, sand screening or gravel washing)	30	
No. of employees 10 (the chance of fire from carelessness depends on the number of hands)	4	
Gasoline engine	10	
Wood pulleys in elevator head	20	
Total of deficiences.	86=	.32
		$ .69
Credits for superior construction:		
Cement first floor	5=	.03
No plastered or sheathed ceilings	5=	.03
		$ .63
Credits for private fire protection:		
Chemical extinguishers	5=	.03
Night watchman	5=	.03
		.57
No signs posted prohibiting smoking		.10
Rate per $100 of insurance		$ .67
	Per cent	
Basis, 2-story FRAME building		$ .69
Following charges are percentages of the basis:		
Area, 3,000 sq. ft. per floor	6	

Metal stove pipe through roof 15	
No masonry foundations 8	
Occupancy (stone crushing, etc.) 50	
Elevator or conveyor of wood 10	
Elevator boots inaccessible and oiled from a distance...10	
2 Gasoline blow torches for repair work. 6	
Total of deficiencies: 105=	.72
	$1.41
Credit:	
No furnaces in building ..... 5=	.07
	$1.34
Exposure to adjoining power house (chance of transmitted fire)	.09
Rate per $100 of insurance	$1.43

* The basis includes all the small and indefinite hazards which cannot be analyzed statistically. The basis varies according to the height of the building, the caliber of public fire department (all towns in the country being graded in ten classes) and the fire record of each state.

New Harvey Gasoline Locomotive

A recent product of the Harvey Motor Truck Works, Harvey, Ill., is a narrow gauge gasoline locomotive for general industrial work.

A specially designed reverse transmission gives the locomotive the Ford high, low and reverse gear reductions for both forward and reverse, making three equal speeds forward and three reverse. Ford 1-ton truck parts are combined, such as motors, rear axle, steering gear, etc., making a compactly designed locomotive weighing 5,000 pounds.

The drive is Ford 1-ton truck worm rear axle used as jackshaft and equipped with driving sprocket for heavy roller chain from jackshaft to rear axle and from rear axle to front axle, applying power to all four wheels. The speed is eight miles per hour both forward and reverse, and the gear reduction is 16.8 to 1, 46 to 1, and 70 to 1.

Illinois Highest in Road Building

FROM January of this year to date Illinois has built almost twice as much highway as any sister commonwealth, and at the present rate will probably outdistance every other state in the union by next January 1. She has been the leader in concrete road construction for the last three years, and this year has built more than one-sixth of all the concrete highways constructed in the union.

On January 1, 1924, Illinois had about 2,991 miles of concrete highway, 18 feet wide; California had 3,288 miles; New York had 2,241 miles; and Pennsylvania had 2,083 miles. Since that time Illinois has built 10,617,073 square yards, and California only 1,563,929 square yards.

Illinois' yardage last year was 11,005,959, or more than one-fifth of the nation's total. The year before it was 6,603,025 yards, or considerably more than one-eighth of the aggregate yardage of the nation. The figures for the United States as a whole for three years were 57,444,970 in 1924; 54,888,224 in 1923; and 46,994,118 in 1922. In 1922 the nearest competitor to Illinois in road building was Pennsylvania, which laid 4,879,937 square yards. Wisconsin was second with 3,484,144; and New York was third with 3,476,922. California came last with 3,156,617 square yards.

The Record by Figures

An interesting comparison of the actual road laying yardage done in the various states is presented in the following table:

State	1924. Sq. yds.	1923. Sq. yds.
Illinois	10,617,073	11,005,959
Indiana	4,053,596	2,800,724
Michigan	5,609,370	3,365,633
Iowa	1,028,310	1,008,528
Wisconsin	549,978	4,567,117
Pennsylvania .	5,814,514	3,853,018
New York	5,309,568	4,191,067
Ohio	2,255,829	2,586,706
California	1,563,929	1,737,107

Now that Illinois has approved of the road building program of her chief executive and his government by voting the $100,000,000 bond issue in the November elections, it is expected that the mileage of highway laid in future will continue to compare very favorably with the state's past record and that of other states.

Stony Creek Gravel Company Operating New Plant

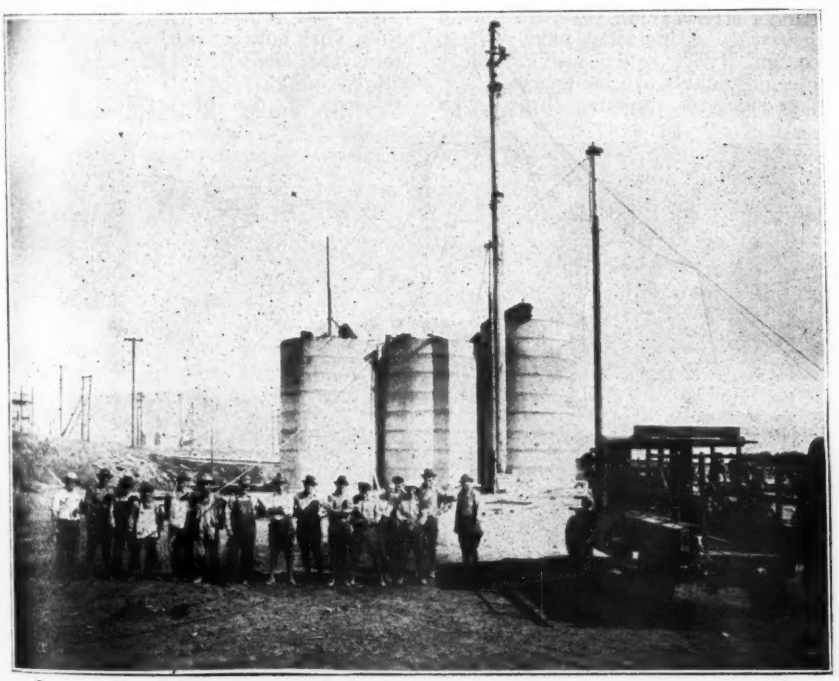
Modern Plant Now Producing Crushed Stone, Gravel and Sand Working Eighteen Acre Deposit at Stony Creek, California

CALIFORNIA is developing rapidly in the production of non-metallic minerals. Some very unusual plants have been constructed and put into operation during the past few months. One of the interesting sand, gravel and crushed stone plants to go into operation this fall is that owned by the Stony Creek Gravel Company.

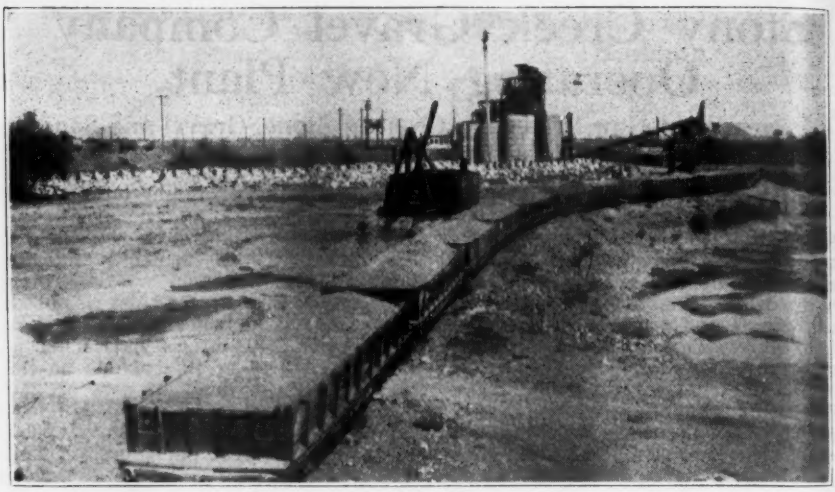
This plant is located at Stony Creek between the State Highway and the Southern Pacific Railroad one mile north of Orland and seventeen miles north of Willows. The deposit covers eighteen acres of gravel, boulders and sand with a depth of 35 feet. The sand is a very hard flint. The tests on the gravel, crushed rock and sand have shown the material to be unusually good.

A Sauerman ¾-yard bucket with a Sauerman two-wheel carrier and dump control and running on a Sauerman cable brings the material into the plant. The track line is 1⅛-inches, the bucket line is ¾-inches and the tension line is ⅝-inch. A Sauerman two speed two drum hoist is used. This hoist is driven by an 80 H.P. motor with 440 volts. This hoist is one of the first of its type to be installed in California. It digs at 250 feet per minute and hauls at 750 feet per minute and has a return speed of about 1,200 feet per minute. The span across Stony Creek is 750 feet. The hoist house is built of corrugated iron. It is 30x40 feet and was built around the hoist in panels that can be removed or opened for repairing or moving the hoist.

A Sauerman wood mast has been installed. This mast is 93 feet high and is mounted on 30 foot concrete tank giving a total height of 123 feet.



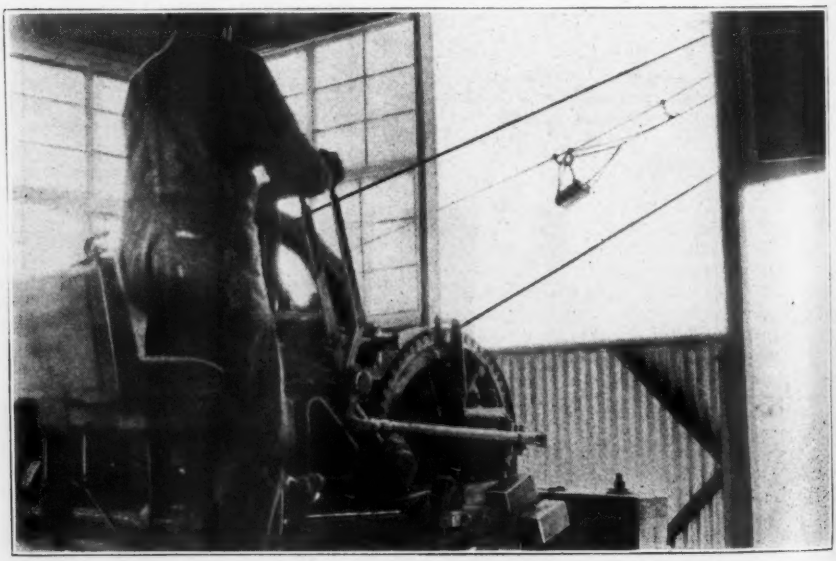
A View of "The Gang." Mr. Twede at Extreme Left.



View from Highway Bridge.

The top of the mast has four steel plates ½x16 inches and 12 feet long. These steel plates are bolted through the mast two ways. The mast bands are 24 inches in diameter and all blocks swivel from the bands. This mast was built of this size in order to handle a Sauerman 1½-yard bucket which will be installed next spring. Skookum Hyatt roller bearing block single and double are being used.

Six concrete bunkers, three on a side, have been erected. The two bunkers under the dump hopper for the bucket are 35 feet high and the other four are 30 feet high. Each bunker is divided in half by rod ties and 4x12 timbers that are well braced. Each bin has a rack and pinion gate for delivering the material onto a New York belt conveyor. Each bunker holds two sizes of material. Through the twelve gates, two to each bin, any desired mixture of crushed rock or



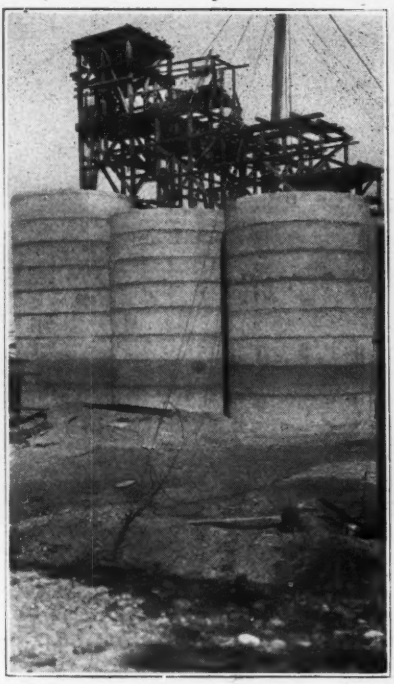
Interior View of Hoist House.

gravel or both can be obtained as well as the one size. The superstructure of these bunkers is built of heavy timber and spans both rows.

There are two sets of screens, one over each row of bunkers, driven from a main line shaft with Whitman friction clutch control. This makes each set independent of the other. The total screen capacity is 100 tons per hour. There is a separate screen for handling creek run and this screen takes out everything over 2½ inches. This screen layout gives crushed rock on one side and gravel on the other. All material passing the ⅛-inch screen is washed in a sand drag tank. The screening plant was built for handling the 1½-yard bucket which will be installed in the spring.

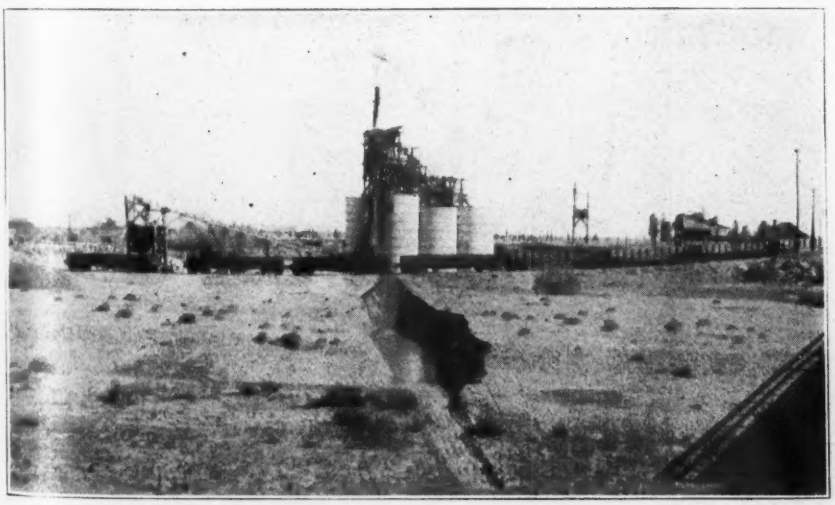
Material that does not pass the 2½-inch screen is sent to an Acme jaw crusher with a 9x15 opening. The discharge from the crusher is delivered by gravity to a continuous bucket elevator on a New York twelve inch belt 63 foot centers that delivers the material to the screens. The company expects to install a number two or three Telsmith crusher for secondary crushing. This crusher will be installed this winter and will handle the material down to ¾-inch.

Water for washing is pumped from a 12-inch well 133 feet deep by a Goulds 4-inch split shell pump directly connected to a Fairbanks-Morse 20 H.P. motor. This pump delivers 750 gallons per minute. Water is piped to the grizzley bars and to each screen and then from the top of the sand drag box is taken to a reservoir where the silt is stored for black base.

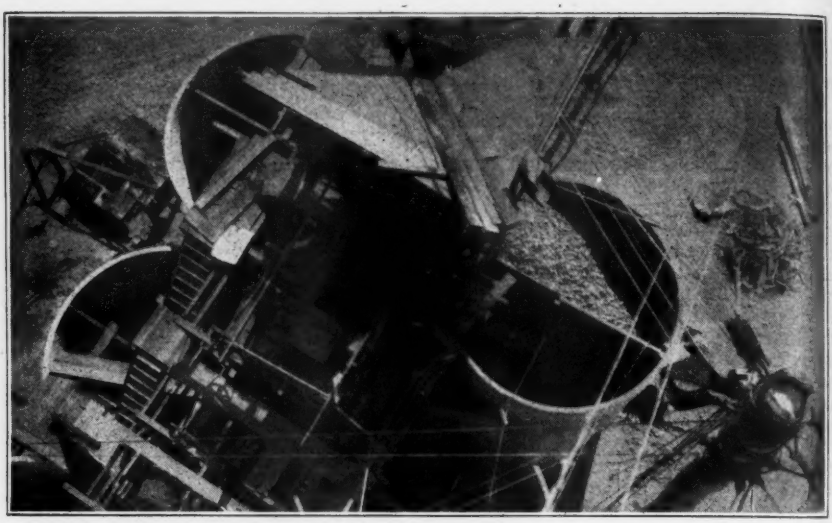


East Side of Bins.

The material is fed from the bunkers to a New York 18-inch belt conveyor of 171 foot centers and conveyed



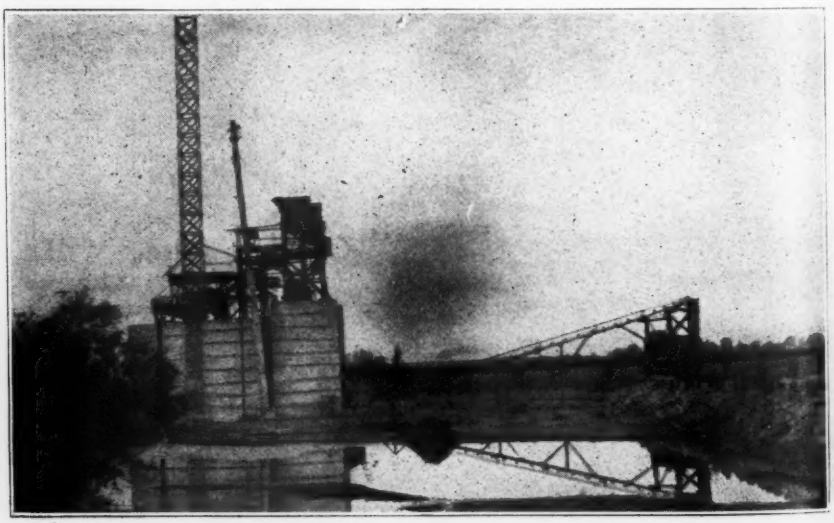
Looking Northwest from Railroad Bridge.



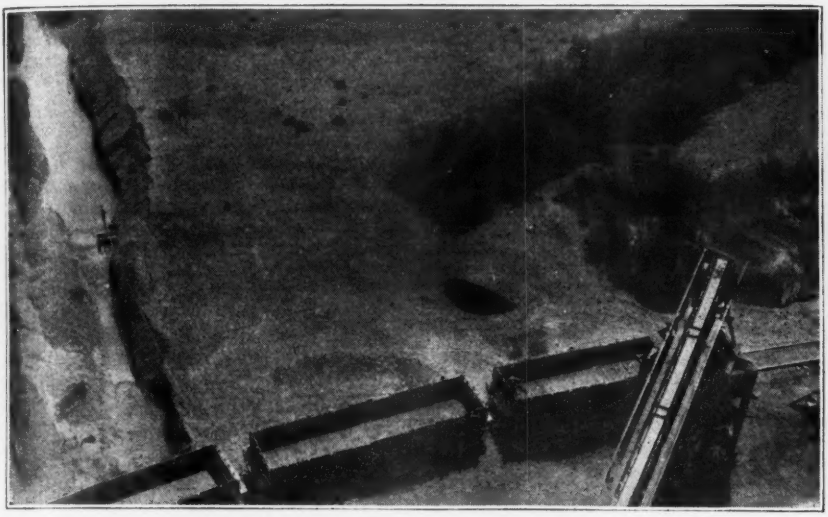
Looking Down from Top of New Mast.

to a loading hopper for loading into trucks or into railroad cars by chute. Railroad cars of 36 cubic yards capacity can each be loaded in fifteen minutes. The car space at the present time is limited to nine cars at a time. This limitation is due to the distance between the loading hopper and the main line track but with two shifts this service will be doubled. Cars are moved by gravity to the loading hopper and after loading are pulled two at a time by a car puller, of the company's own design, down the spur track.

The power is all electric and furnished by the Pacific Gas and Electric Company. All motors are 440 volts three phase 60 cycle. A Lincoln 80 H.P. motor is operating the hoist. Two General Electric motors are operating the conveyors and screens. One is 10 H.P. and the other is 25 H.P. A Westinghouse 20 H.P. motor



A General iew from West Side of Plant.

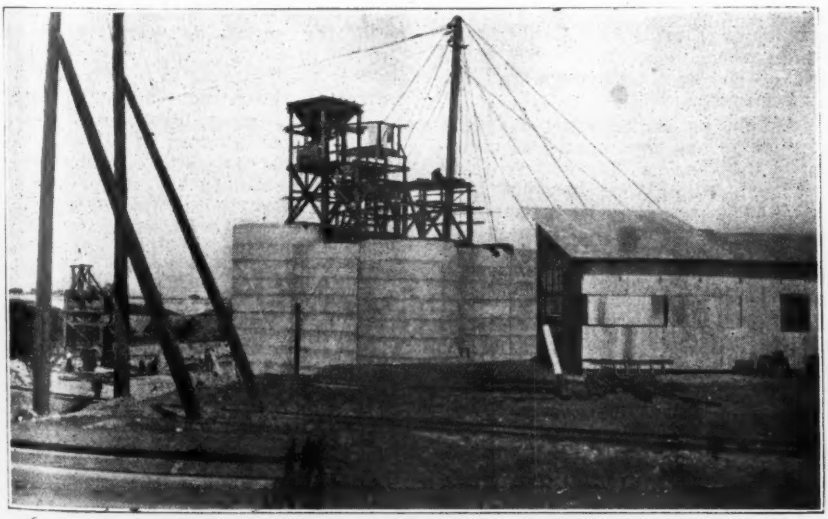


A View from Top of New Mast.

drives the pump and a Fairbanks-Morse 15 H.P. drives the car puller. The power rate is three cents for the first 1,000 K.W.H. and two cents for the next 1,000 K.W.H. and one cent for every additional 1,000 K.W.H. The power cost to date has averaged $170 per month.

Four men operate the plant on one shift. Six men can operate it on two shifts. This is with one man on the hoist, one man at the screens, one man at the bunkers and belts and one man loading trucks or railroad cars. The bunkers are of sufficient capacity to hold over one shift without danger of tying up operations.

The plant was designed by the Bodinson Manufacturing Company of San Francisco and all conveying, screening and transmission machinery, not mentioned as the product of some other concern, was manufactured by them.



View Taken During Mounting of Machinery.

Winter Precautions for Your Truck

By R. E. DEVOGT*

WITH cold weather rapidly approaching, the truck operator should immediately take necessary precautions to insure satisfactory performance of his truck during the winter months.

The cooling system naturally should be the first to receive attention. In cold weather, the cooling system should be drained and filled with a solution that will not freeze when the truck is allowed to stand. The best anti-freezing mixtures are composed of denatured alcohol and water as follows:

Alcohol	Water	Specific Gravity	Freezing Point
20 per cent	80 per cent	.9780	19° F. above zero
30 per cent	70 per cent	.9680	10° F. above zero
40 per cent	60 per cent	.9570	2° F. below zero
50 per cent	50 per cent	.9430	18° F. below zero

As the alcohol tends to evaporate more rapidly than the water, thus raising the freezing point of the solution, it is necessary to add alcohol at frequent intervals. With the aid of a hydrometer the specific gravity of the solution can be determined and the corresponding freezing point obtained from the foregoing table. In making gravity determinations, care should be taken to have the temperature of the solution being tested between 55° and 65° F. or serious errors will result. Solutions containing calcium chloride and similar compounds tend to corrode the metal parts of the cooling system and are not recommended.

It should be remembered that the water which has been heated to a certain point has a higher freezing point than water that has not been heated. so it is well to be prepared in case of an unexpected cold snap. In addition to using an anti-freeze mixture, the lower half of the radiator should be covered during the colder days of winter. In doing so, you will maintain higher engine operating temperatures, which will be reflected in the operation of your motor. Unless this precaution is observed, the excess of raw fuel which enters the combustion chambers, through the excessive use of the carburetor choke in cold weather, will work its way past the piston rings into the crankcase with the resultant dilution of the lubricating oil which causes undue wear of all working parts of the motor.

The choker should not be used any more than is absolutely necessary to start the motor and to keep it running until warm. During the winter months the crankcase should be drained and refilled with fresh oil at periods from 300 to 500 miles. While you would save on your oil bill by neglecting this, your saving will be more than offset when the time comes to overhaul your motor. It is important that the best oil obtainable be used for the reason that there is bound to be some crankcase dilution during winter operations and it is essential that the oil be of sufficient body to resist the cutting action of the fuel that works into the oil supply.

It is also a good plan to drain off about one-half pint of oil every two or three nights during the winter while the engine is warm; as in a number of cases it will be found that the oil contains water, the result of crankcase sweating, due to rapid changes of temperature. In draining off of a small amount of oil. the water will come out with it. By doing this, you eliminate the possibility of emulsion of dirty oil and water. Oil when clean will not emulsify with water but after a short period of service, oil will acquire dirt and sediment which forms a binder between oil and water, causing sludge, which will eventually clog the oil lines and stop circulation. In aggravated cases of water accumulation, the water may freeze over night and cause the pump shaft to break when the motor is being started.

If you have not been in the habit of taking these precautions, start now, as you will be repaid with lower operating costs and a longer life for the motor.

*Director of Service for Republic Motor Truck Company.

Fuel Conservation in Cement Mill Operation

Written Expressly for PIT AND QUARRY by CHARLES LONGENECKER.*

THERE is probably no subject of more universal interest than fuel conservation. It is a subject which cannot be passed by with a gesture for it makes its appearance monthly in the balance sheet and it must receive recognition. There was a time when the fuel item on the "cost of production" sheet received scant attention but competition and a diminishing supply of high quality fuel have forced this particular item into the most prominent position.

In 1922 the production of cement in the United States totaled 115,000,000 barrels. The coal burned in the production of this output was approximately 11,500,000 tons. This includes coal for firing the kilns and the production of the power required to operate the machinery. Theoretically it is possible to burn a barrel of cement with a fuel consumption of 30 pounds of coal of good quality. Assuming three times this amount is burned the saving would approximate 6,330,000 tons of coal. This saving while doubtful of attainment indicates the wide difference between present practice and the ideal goal.

Fuel conservation is another name for fuel saving. To save fuel all losses should be eliminated as far as is practically possible. We all appreciate the impossibility of eliminating all losses as engineering practice has not reached the stage where this is feasible. The losses in the cement kiln, which must receive the attention of engineers, are as follows:

1. Loss of heat in the gases passing from the kiln.
2. Loss of heat in the clinker.
3. Loss of heat by radiation.

The sum of these losses plus the heat utilized in useful work will equal the heat in the coal burned. It is desirable to spend no more heat than necessary in this useful work but this item is a constant quantity for every particular plant and cannot be reduced below a certain minimum. It depends on the process and the local conditions.

The heat expended in the kiln must drive off the moisture in the raw material and decompose the carbonates of magnesia and lime and then heat the material to the temperature at which the oxides of lime and magnesia will combine to form the compounds which form the cement clinker. In the formation of these compounds the reaction is "exothermic" and gives out heat instead of absorbing it. Professor Jos. W. Richards of Lehigh University made a balance of the heat expenditures which has been generally accepted as a close approximation to actual conditions obtained in the kiln. His results are as here shown:

Heat in Coal		790,000 B.T.U.
Heat of combination of ingredients forming the clinker		142,819 B.T.U.
Total		932,819 B.T.U.
HEAT DISTRIBUTION		
Heat in hot clinker		100,050
Heat in Chimney gases		
In the excess air	336,000	
In the necessary products	340,000	
	676,000	676,000
Heat in flue dust		2,112
Loss by imperfect combustion		12,248
Evaporation of water		1,446
Expulsion of CO_2 from carbonates		21,628
Loss by radiation and conduction		119,335
		932,819

It must be appreciated that heat balances such as the above are open

*Engineer, Combustion Engineering Corporation.

to minor discrepancies due to the lack of authoritative knowledge in regard to the thermochemical data involved in such a computation. The balance enables one to readily visualize the losses. The loss of heat carried away in the hot clinker is 11 per cent. The chimney gases carry with them 72 per cent. The loss by radiation and conduction amounts to 13 per cent. The other losses total 4 per cent.

From these figures it is apparent that the greatest saving can be made by reclaiming heat from the chimney gases.

There are about 120 cement manufacturing plants in this country. Of these some 30 have been equipped with waste heat boiler and are generating enough steam to meet from 50 per cent to 100 per cent of the power needed to operate the mills. The coal saved in these plants will run from 30 to 50 pounds per barrel of cement. It has been estimated that for every barrel of cement produced 200 pounds of coal are burned. This includes both that burned in the kiln and for power purposes. Some plants of course have a fuel consumption materially below this. Waste heat boilers assuming a 50 pound coal saving will reduce this figure to 150 pounds of coal at least.

The temperature of the gases leaving the kiln will average 1,400° F. and these can be reduced to 450° F. by installing waste heat boilers together with economizers. A fan will draw the gases through the economizer. The first installations with waste heat boilers were not a success due to troubles arising from the dust carried along with the gases. This trouble has been overcome by improving the design of flue connections from the outlet of the kiln to the boiler. A large percentage of the dust settles in a chamber in which the velocity of the current is reduced. A lance is used to blow the dust off the tubes two or three times in twenty-four hours. This heat in the waste gases could be utilized also in heating the air for combustion or for drying the material from which the cement is made.

So far practically no advance has been made in heating the air for combustion due to the mechanical difficulties in carrying out the exchange of heat. In recent years there has been a very considerable development in the adapting of recuperators to different types of furnaces and kilns. These recuperators are very accessible and the flues through which the waste gases travel are easily cleaned. Undoubtedly recuperators installed on cement kilns would effect an additional saving that would amply warrant the investment. This is a field in which great possibilities are presented.

Drying the raw material has been effected to a great extent by the lengthening of the kiln. When kilns were increased in length from 60 feet to 150 feet the saving in fuel which resulted justified the innovation to such an extent that all modern plants have long kilns. It has been remarked that kilns approximately 260 feet would utilize all the heat in the gases in drying the fuel.

The loss of heat from radiation and conduction has been reduced by insulating the kiln over the greater part of its length. Due to the high heat carried in the kiln at the burner end it is not practical to insulate that part. Insulation here causes the refractory lining to give way too rapidly as the brick becomes too hot and "spall" off. The kiln can be insulated to about 75 per cent of its length by placing the insulating material between the brick lining and the steel shell. It is a difficult matter to determine the loss but on an uninsulated kiln it has been estimated that 1,000 B.T.U.'s are lost per square foot of surface per hour. One authority states that by preheating the air and insulating the kiln not over 75 pounds of coal should be required per barrel of product.

The third loss is due to the heat in the clinker as it drops from the kiln. It is a real problem to reclaim this heat. Attempts have been made at various times and "coolers" have been devised but the success of these is very much of a question. If it were possible to return to practical use the heat in the clinker there would be a saving of approximately 15 pounds of coal per barrel of cement. The clinker leaves the kiln at approximately a temperature of 2,000° F. The quantities here given are for plants with a fairly large barrel output per day.

The remaining four items entering into the heat balance given by Prof. Richards are small in amounts. The loss by imperfect combustion is largely a matter of the kiln control as regards coal and air supply. Powdered coal is the fuel generally burned and

this fuel can be burned with very little loss. For the burning of powdered coal the cement kiln is ideal. The flame travel is long and heat is radiated into the stream of coal and air so that ignition is immediate. Temperatures as high as 2,900° F. are required in the hottest zone and if the air and coal ratio is correct and mixture proper there is no need for unburned fuel. Should a slightly reduced flame be carried there would be some CO in the products of combustion.

The evaporation of the water and the expulsion of the carbon dioxide are necessary evils and cannot be avoided. The water must be driven off in the kiln or outside of it and heat must be expended so it is simply a question of where it is most expedient to have this function performed. The specific heat of water in gaseous form is high and hence the heat required to raise the temperature of the water to say 1,400° is a very appreciable item.

Fortunately for the cement manufacturer the coal which is burned in the kiln is somewhat of a by-product and can be purchased at a comparatively low price. When coal is screened the fine slack makes an ideal fuel as long as the ash content does not run extremely high.

Other fuels such as oil and producer gas have been burned in cement kilns but these fuels present no advantages over powdered coal from a thermal viewpoint. In some localities oil can be purchased at a price that makes it attractive.

In any consideration of fuel conservation the personal factor is most important. Unless the organization operating the kiln understands the control of the coal and air and keeps the proportions accurate there is a great probability that fuel will be wasted.

New Incorporations

The Freeland Stone Company of Sellersburg, Indiana, has been incorporated for $40,000 to quarry and crush limestone. Directors are: Myron Freeland, Paul E. Freeland, and Emma F. Freeland.

The Moulding Sand Company of Albany, N. Y., has been incorporated for $10,000 by M. P. Davis and A. R. Fox.

M. E. Maney, of Smithville, Texas, and associates of Houston, have formed a partnership in the sand and gravel business and will open a plant on the Colorado river. A huge motor-driven caterpillar shovel is being installed which will load 30 or 40 cars a day. Later a gravel washing plant will be put in.

The Hattiesburg Gravel and Sand Co., Inc., of Wilmington, Del., has been incorporated for $40,000 to deal in sand and gravel, by T. L. Croteau, M. A. Bruce and A. M. Hooven.

The Niles Mill and Lumber Co., 724 Pither Ave., Evanston, Ill., has been incorporated for $40,000, to deal in sand, stone, coal and fuel, by Jessie C. Traweek, W. S. Traweek, John L. Gaffney.

The Jacksboro Crushed Stone Company of Jacksboro, Texas, has been incorporated with capital stock of $75,000 by L. P. Lively, W. W. Hyde and Hal Mosely.

The Prime Cement Block Mfg. Co. of Brooklyn, N. Y., has been incorporated for $20,000 by J. Brenner, J. Goebel and G. W. Miller.

Articles of association have been filed by McColl & Abare, Inc., of Barre, Vt., to engage in quarrying, cutting and manufacturing granite, marble and other stone. Capital stock, $10,000, divided into 100 shares, par value $100 each. Incorporators are Thomas Abare, Reginald Abare, Zeno Broe and Gerald Fournier.

The Ridge Sand & Gravel Corporation of Rochester, N. Y., has been incorporated for $10,000 to carry on a sand and gravel business. Directors are: Herman and Myrta Hutcheson, of Rochester, and Wilford Purchase of Newark, N. Y.

The Bunnell Coal Corporation of Springfield, Mass., has been incorporated to handle cement, feedstuffs, fuels and lumber. Capital stock, $50,000. Incorporators are Robert K. Nickerson of Hampden, and George W. Doyle, Louis J. Gordon, Ida Gordon and Gladys E. Elliot of Springfield, Mass.

S. A. White Co., Inc., of Wilmington, Del., has been incorporated to quarry rock and do road building. Capital, $100,000. Incorporators: Charles G. Guyer, R. T. Kenton, S. E. Phillips, of Wilmington.

The News at Washington

By Our Washington Correspondent

THE National Sand and Gravel Association, through Earl Zimmerman, of the Ohio Gravel Ballast Company, of Cincinnati, chairman of the Washed Gravel Ballast Committee of the Association, is making a thorough investigation into the practicability of the use of gravel as railroad ballast. If the investigation shows that gravel is a suitable and economical ballast it will open up a new and extensive market for producers, it is stated. Other members of the committee are: Guy C. Baker, vice-president of the Greenville Gravel Company, Greenville, Ohio, and M. A. Neville, president of the Western Indiana Gravel Company, Lafayette, Ind.

At a recent meeting of the committee, the proposal to promote wider use of washed gravel as railroad ballast was gone thoroughly into. The proposal was initiated by Mr. Zimmerman at the St. Louis convention of the Association. His discussion of the subject at that time and suggestion that a committee be appointed to show the advantages of washed gravel railroad ballast were approved by the executive committee, which selected Mr. Zimmerman as the one best fitted to handle the matter for the sand and gravel industry.

The committee has already done a notable work. It has made a survey of the ballast situation on several railroads, getting some information as to cost of gravel ballast compared with other kinds of ballast, together with information regarding life, drainage, maintenance and other conditions.

Mr. Zimmerman is preparing a report of his committee's findings and recommendations. This report will be given to trade journals as soon as it is in shape. He will also discuss the subject at the Chicago convention. According to T. R. Barrows, executive secretary of the national association, the members of the organization are indebted to Mr. Zimmerman's committee for the work it has started. Mr. Barrows says, if found practical, it will lead to the wider and more extensive use of materials produced by members of the organization, and provide an outlet heretofore of a very limited character.

Producers of sand, gravel and other materials shipped in open-top cars will be interested to know that an order of the Interstate Commerce Commission restricting and regulating the distribution to coal mines of privately owned cars and cars for railroad fuel, which was to have become effective November 1, has been postponed by the commission until December 15. The commission's decision in the case, made June 30, 1923, held to be unjust the practice of railroads in assigning private cars and system cars for railway fuel to bituminous coal mines in excess of the ratable share contemporaneously distributed to bituminous coal mines upon their lines which do not receive assigned cars. After the issuance of the first order the case was reheard. While the commission made no explanation of the order, it was indicated that the order was postponed pending a decision on the rehearing.

The Department of Commerce announces that, according to data collected at the biennial census of manufactures, 1923, the establishments (not including textile mills) engaged primarily in the manufacture of steam and other packing, pipe and boiler covering, and gaskets, reported products valued at $29,497,021, an increase of 33.6 per cent as compared with 1921, the last preceding census year. In addition, steam and other packing, etc., are manufactured to some extent as secondary products by establishments engaged primarily in other industries. The value of such commodities thus made outside the industry proper in 1921 was $3,499,064, an amount equal to 15.8 per cent of the total value of products reported for the industry as classified. The corresponding value for 1923 has not yet been ascertained but will be shown in the final report of the present census. At the same time, the department reports that establishments in the clay-products industry engaged in the production of face brick and vitrified brick or block for paving reported the manufacture of face brick valued at $37,637,972, as compared with $28,233,689 in 1922 and $18,128,217 in 1921, an increase of 33.3 per cent over 1922 and 107.6 per cent over 1921. The total value of vitrified brick or block for paving was $11,359,640, as compared with $9,520,594 in 1922 and $11,201,409 in 1921, an increase of 19.3 per cent over 1922 and 1.4 per cent over 1921.

Each succeeding week adds to the record-breaking total of loadings.

Ward Sand and Gravel Company Producing 200 Cars Daily

Model Plant with Large Scale and Continuous Production Duplicate Units of Pumps and Pipe Eliminates Shutdown

MICHIGAN is especially noted for its many practically inexhaustible sand and gravel deposits. One of these deposits is being worked by the Ward Sand and Gravel Company at Oxford Michigan. The Oxford plant of this company is the largest in the State of Michigan and probably the largest in the country.

The deposit, covering 300 acres, is on the edge of the village of Oxford. This little village has a population of 2,000. The deposit lies in stratas of about two feet of small pebbles then a few inches of sand and the next strata of small pebbles and a few inches of sand. Clay and debris of all kinds is noticeably absent. Considering the whole deposit the sand probably runs about 50 per cent. Engineers estimate that operations, producing at the present rate of 200 cars daily, can be continued for 300 years to advantage. The land was purchased by the company at $100 an acre.

Five of the largest plants in Michigan are located in Oxford. In addition to the Ward Sand and Gravel Company there are the Fuller Becker Sand and Gravel Company, United Fuel and Supply Company, Koenig Coal Company and the Detroit Oxford Gravel and Stone Company. These plants are in Detroit area and practically their entire output is distributed through Detroit.

The Ward Sand and Gravel Company have two and a half miles of railroad siding at the plant and shipments are made over the Grand Trunk Railway System and the Michigan Central. Single cars have been loaded in ten seconds but for continual loading the record is 31 cars loaded in 62 minutes.

The Ward Sand and Gravel Company have spared no expense in making this plant a most modern sand and gravel plant of large continuous production. Operations extend through seven or eight months of the year. This year the plant will have shipped over 36,000 cars of sand and gravel.

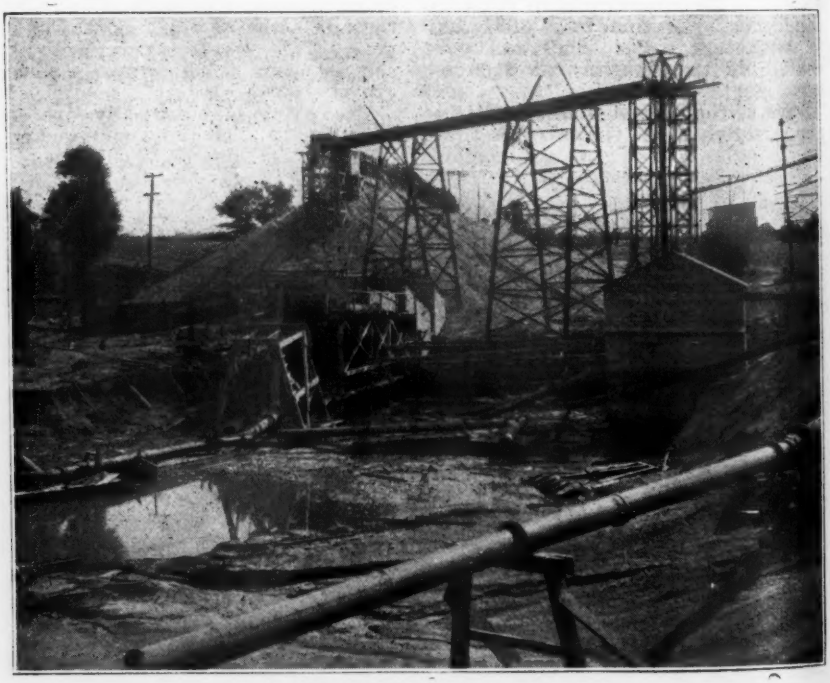
The plant is electrically operated throughout. The large motors are 3

View Showing Bank of Deposit.

Water System of Breaking Down Deposit.

phase 60 cycle 2,300 volt and some of the smaller motors are 220 volts. All are General Electric motors.

In excavating the material a low pressure stream is directed against the bank above the water line. This stream of water loosens and carries the caved material to the suction pipe. The material below the water line is excavated with 16 inch Morris heavy duty dredging pumps. There are two of these pumping units mounted on a specially designed dredge. A covered barge is attached to the rear of this dredge for housing the starting resistances for the large motors. A complete workroom which also serves as a store room is located on the dredge.



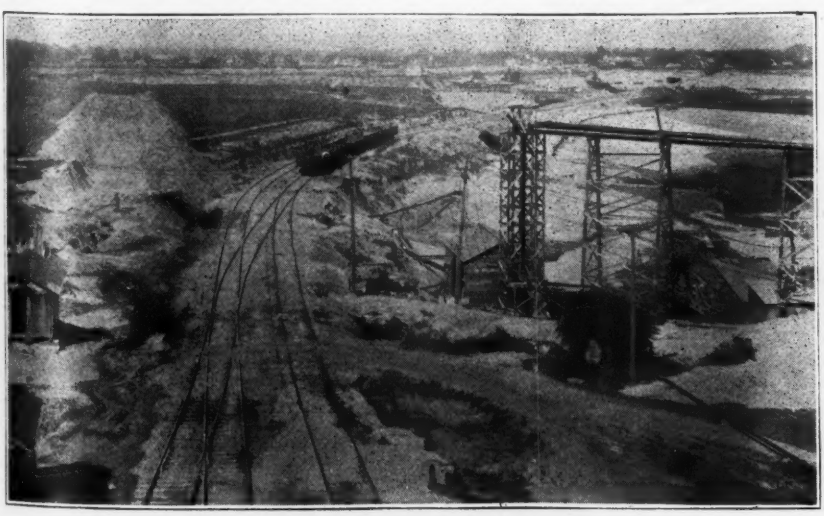
Showing Small Section of Pipe from Dredge.

Each unit is made up of a suction with a Morris suction nozzle and a Morris 16 inch dredging pump driven by a 400 H.P. General Electric motor. Water for the hydraulic stream on the bank, the bearings and for priming the pump is supplied by a Morris 6 inch centrifugal pump driven by a 100 H.P. General Electric motor. The suction pipe is handled by a Thomas hoist operated by a 15 H.P. General Electric motor. The two pumping units for under water excavation are mounted side by side on board the dredge and each is connected separately to a motor. This duplication with other duplicate units to be mentioned, eliminates all danger of shutdown or interruption as only one unit is operated at a time. The other unit is held in readiness in case of a breakdown.

The suction pipe is mounted on a steel bridge with intake end of which is mounted on a pontoon. The position of the dredge is controlled by lines connecting with deadmen on the shore. The material is excavated from a depth of about 30 feet below the water surface and with the 35 feet above the water surface the total working face is 65 feet.

The material is pumped through about 1,100 feet of pipe line with a lift of about 70 feet. This pipe line runs from each pump alongside the dredge to the rear of the barge where it is connected to the main line. This main line pipe is on pontoons which carry it to the shore. The pipe line consists largely of American Rolling Mill Company pipe. Due to the long pipe line and the high lift a booster pump is located on shore for each unit. The pumps on the dredge, the booster pumps and the suction and discharge pipe are in duplicate. This is rather unusual but it eliminates any danger of shutdown.

The pipe line conveys the material to the main gravity washing screen near the shore about 20 feet above the water level. This screen is 30x12 feet. The oversize material is screened out first and is delivered to a number 7 Acme jaw crusher. This crusher discharges to a belt conveyor which delivers material to the screens for classification. The gravel is screened out next and is delivered to the screens by a 30 inch belt conveyor while the sand and water are conducted to sand settling boxes. This sand falls through the main washing screen into a pool. A 16 inch Amco centrifugal pump driven by a 400 H.P. General Electric motor pushes the material up and elevates it through a pipe line to the sand box. This box is 5x2 feet at the top and 2x2 feet at the bottom. This box discharges to a wood sand flume which is 120 feet long and four feet wide. The bottom of this flume has 1⅜ inch holes, four in a row, starting about 10 feet from the receiving end and spaced 2 feet apart the remaining length of the flume. By using plugs in these

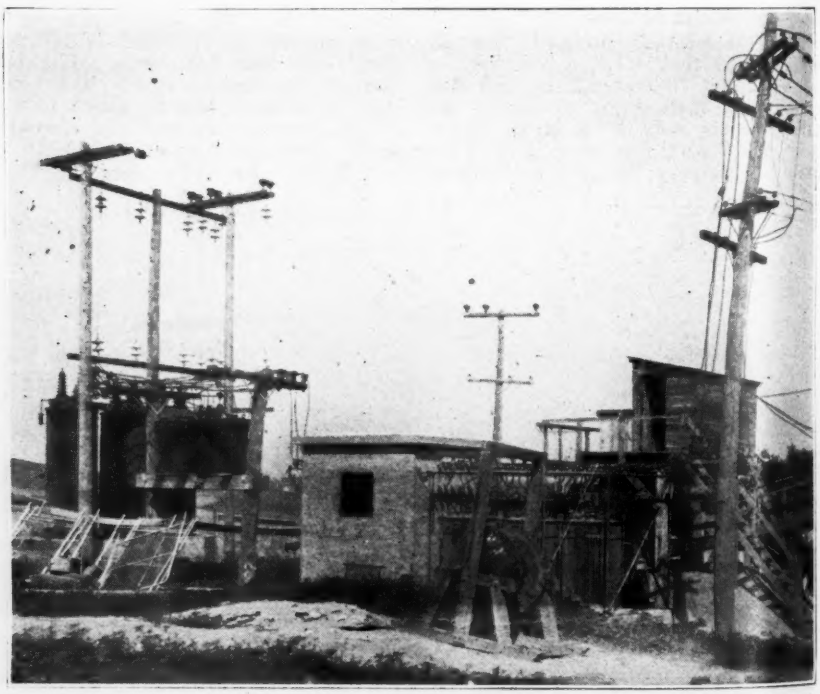


Michigan Central and Grand Trunk Railway.

Electric Generator and Conveyor Belt.

holes almost any required grade of sand can be secured.

The sand is deposited through the holes in the bottom of the flume onto storage piles. The material is reclaimed from these storage piles by a 24 inch turned belt conveyor which conveys to the loading bins over the railroad track. The waste and sulphur sand is drawn off at the discharge end of the flume and delivered back to the pond. As the material comes through the sand box to the flume it is thoroughly agitated. The



The Electric Power Plant.

discharge to the flume from this sand box is covered to prevent material splashing over the flume.

There is another 16 inch Amsco pump at the main screen that serves as a duplicate unit that can also be used for delivering any material in excess of the current need to a storage pile.

The oversize before going to the Acme crusher passes over a grizzly built of rectangular bars spaced two inches apart. The gravel or material from 2 inches down to one quarter of an inch is transported underground beneath the railroad tracks and then up a slight incline to a belt conveyor at right angles which transfers the material up an 18 degree incline where it is transferred to another belt conveyor on a trestle. This trestle conveyor delivers the gravel to two Mitchell screens where the several sizes are graded. Each of these Mitchell screens is protected by a wire screen of a little larger mesh than the Mitchell screens. This arrangement reduces the wear on the screens by keeping out all oversize. This oversize material is plowed from the belt conveyor before the material reaches the Mitchell screens. A strip of rubber belt on this plow arrangement prevents material catching underneath and causing excessive wear on the belt conveyor.

The material is stored on the ground and is drawn off underneath the storage piles by a tunnel belt conveyor. This 30 inch tunnel belt conveyor receives the material through the bin gates and carries it up an incline to a loading bin over the tracks. Cars are loaded from this bin by gravity. The cars are spotted under the bins with the use of a two drum Thomas hoist as car puller. There are two loading bins over the railroad track. The incoming cars jolt the loaded cars and with this momentum they travel down the track by gravity. The plant is located on a double track spur which extends some distance beyond the plant. With continuous loading a car, on the average, is loaded every two minutes.

The trestles for the conveyor belts and pipe lines are built of heavy timber. The tunnels are also lined with timber. The loading bins are built of heavy timber.

The plant is operated continuously averaging about 20 hours a day actual running time. There are 58 men employed at the plant at this time. These men are divided into two shifts of 12 hours each.

A feature of this plant is the installation of jet heads on the end of the suction pipes. There are eight ⅞-inch nozzles around the intake which are supplied with water under a pressure of 100 pounds per square inch. These eight jets of water coming from the nozzel under the high pressure break up the material in front of the suction and insure a steady flow into the pump. The vacuum is held constant with these suction heads.

In each suction line there is installed close to the pump a Morris stone box which is set to pass material under 7 inches in diameter. Material over 7 inches is retained in the stone box and is emptied about

View of Conveyor System and Bins.

twice a day. These stone boxes are so arranged that they can be taken out and cleaned with the minimum loss of time. The pumps are adjusted to handle all material under 7½ inches in diameter and this is sufficient for everything except the few occasional large boulders removed by the stone box. The use of these stone boxes has made it unnecessary to delay operations to pry stones out of the suction hose which is such a frequent occurrence in many cases.

The discharge pipe line is made of light gauge steel plate electrically welded Armco pipe. The plate is of special composition made especially for this class of service.

The plant is electrically operated by power purchased from the Detroit Edison Company. Each unit is driven by individual General Electric motors.

The output of this plant is consumed largely in the construction of roads, buildings and concrete bridges. A considerable portion of the output is also consumed by the railroads who haul in a train of freight cars and have it loaded in a few minutes without disconnecting the engine.

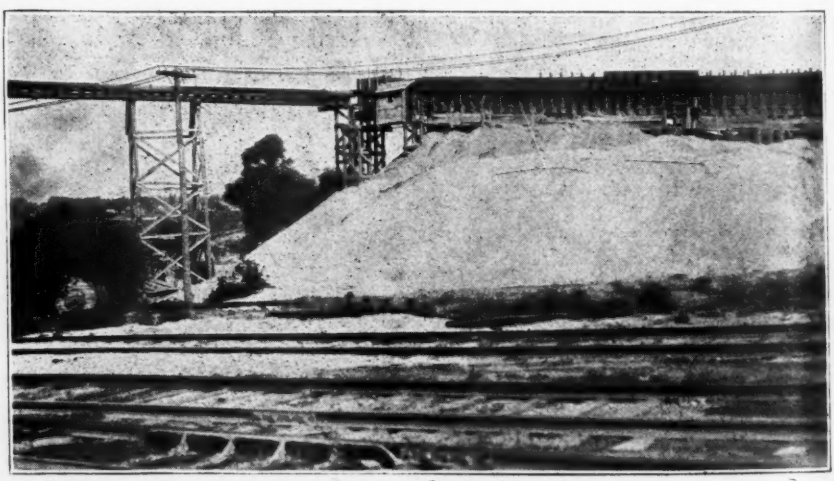
The Ward Sand and Gravel Company have their offices in Detroit. Mr. F. L. Ward is president and general manager. Mr. E. M. Hammond is treasurer and Mr. Charles E. Pelton is in charge of operations at the plant. The plant represents Mr. Ward's ideas of design and construction. He has established an enviable reputation in the sand and gravel business through this Oxford plant which is probably the largest in the country. Mr. Pelton was previously in the automobile industry and he became associated with the company after the plant reached its present large proportions. Mr. Hammond has had years of experience in the building trades and he knows the sand and gravel business thoroughly.

Mr. Ward at the present time is preparing to operate a large deposit outside of Los Angeles, California. He also plans further extensive operations in Michigan.

Western Wheeled Scraper Catalog

Catalog No. 63, just issued by the Western Wheeled Scraper Company of Aurora, Illinois, describes Coal Stripping and the Storage of Coal With Western Dump Cars.

The booklet, it is stated, is inspired by a sincere desire to help reduce the cost of coal production as well as to report the wide-spread use of Western Dump Cars by the Coal Industry. In stripping anthracite the cost of disposing of the overburden is more than the digging, and both operators and contractors are constantly studying how to reduce this cost. The book has many illustrations of operations, and reports of success secured by many operators with Western Dump Cars.



View Showing Track and Sand Bins.

Depreciation of Plant

Written Expressly for PIT AND QUARRY by DANIEL J. HAUER.

IN EVERY set of books kept by operators of sand, gravel and stone producing plants, a careful record should be kept of the expenditure made for plant; and as the years go by, there should be charged off this account depreciation of various items of plant. In addition to this, there should also be an account kept showing the interest for each year on the plant investment. These items become a part of the overhead charge in considering the cost of production and in making a price for sale of the various products.

It is quite surprising how many operators do not keep these accounts on their books. The result is that they know little of overhead costs so that an operation may be showing a loss and they would not be aware of it until the end of the year when a trial balance was taken from their books. This is evidently a wrong method of conducting any business. The depreciation on a stone crusher is just as evident although it may not be as heavy as that on the belt that is operating it, but the cost ultimately of replacing it, is just as sure as that of replacing the belt. Likewise, the belt must be replaced just as much as a hand shovel, yet no one would think of ignoring the charge of buying a hand shovel. Such a charge may be only a dollar or two, and this is entered on the books when the depreciation of a stone crusher that may figure several hundred dollars per annum is given so little consideration as not to make an entry of it on the books.

Every business that has a plant of any kind should keep a full record of these items on the books. They should show the capital so invested, the interest charge on this capital, the repairs and renewals on the plant, and the annual depreciation of each item of the plant. These various charges can be made in one or two accounts or they can be broken up into several accounts, this being to some extent a matter of preference. Under most conditions the more detail given to these matters, the more satisfactory will be the results obtained. The greater knowledge at hand effects a more intelligent handling of the finances of the operation.

The term "plant" can be made to cover many items and a large number of expenses for different charges, but the better plan is to limit it to as few items as possible. Thus some operators include in with their plant their buildings. In the broad sense of the word buildings are part of the plant, but it is preferable to keep a separate account of the buildings and to limit to the plant charge the various machines that are used. Thus plant could really be termed "machinery." There must be a further distinction made between machines and tools although the exact point between the two is hard to define. A shovel or a pick is clearly a tool that can quickly be used if in a quarry business and is in no way a part of the plant. Such a tool should certainly be charged to an expense account. On the other hand, a small hydraulic jack may be considered a tool as far as handling it is concerned, yet it may have a life of ten years or more if it is properly cared for. The cost may be comparatively small when considered with a stone crusher so that it is difficult to decide whether such a tool should be classed under "plant" or "tools." Other tools of this kind could also be mentioned.

Even certain machines that could be ranked as plant should be classed as equipment, and a separate account can be kept of this part of the plant. Items of machines that should go under this heading would include locomotives, cars, trucks, and other machines that are used in transportation. The mere fact that these machines are used for hauling means a greater expense to keep them in repair while they will have a much shorter life than a large and heavily constructed stone crusher will have.

There are some items of expense that are sometimes confused with plant charges and with capital expenditures. In some ways, especially in a new project, these items can use up considerable capital; yet they cannot be realized on again like other capital expenditures. To illustrate: A crusher may be purchased. The freight on this crusher may be $500.00 and the cost of unloading, hauling and installing including the

concrete foundation may be $1,500.00. Here is a total of $2,000.00 of the capital provided for the company being used on this crusher, yet not one cent of it enhances the value of the crusher except for its use at this particular plant. If the crusher were to be sold within a week, this $2,000.00 expended would not cause it to bring a cent more than it would bring in some other location, yet this $2,000.00 had to be expended to make it work at this particular plant. It is, therefore, wrong to charge this $2,000.00 in with the value of the plant or as money invested. This amount of money must be charged to the expense account, and it becomes an overhead charge against production. Although the amount is paid at once and is bound to come out of first season's profit, yet it is questionable whether or not in distributing overhead cost all of this sum should be charged during the first year or spread over a long term of years. If a long term of years is decided upon, it is a matter of dispute among accountants as to how many years should be used.

It can be seen from the discussion so far made that there are bound to be certain items in bookkeeping that can be called "book values" and "real values." Thus a crusher that will cost $10,000 and must have $2,000.00 expended upon it to put in position to work, can have a value to the operator of $12,000 while its real value was originally $10,000; and after five years with 5 per cent depreciation charged annually against it there is a book value against the machine of $7,500.00. If at that time the machine had to be sold, it might bring only $5,000.00 which would be its real value. If such a crusher is used for 15 years and kept in good condition, with five per cent depreciation charged against the machine, its book value would be $2,500.00; while if it had to be sold, it might bring a price of $3,500.00 which would be its real value.

Another question in bookkeeping that arises in regard to plant involves the repairs and renewals that must be made from time to time on all machines. There can be a distinction between a repair and a renewal. A steam shovel may have to have packing placed in its several steam chests and babbitt metal put in some of its bearings. Here the material cost is very small, but the labor cost is much greater. The machine becomes without value unless this work is done. Thus the repairs are necessary but should not be charged to the plant account. They should be taken care of under an expense account headed "Repairs." The same steam shovel may have several badly worn gear wheels. New ones may have to be purchased and substituted for the old ones. The labor is a small item, while the gear wheels must cost considerable. This is an expense that may be termed a renewal and should be charged to such an account.

Repairs may have to be made continually on some machines, while renewals may come only at long intervals. In either case they should be treated as expenses. The question again arises as to what length of time these charges should cover against the production. The repairs should be charged off at once as a direct item of expense, but renewals should go over a season's work. These would be treated in the same manner but for a shorter length of time than other items of general expense that have already been referred to. The fact is that general expense items of some kinds are very hard to handle in pit and quarry operations. For instance, certain stripping may be done during an off season or when the first development is made. This stripping operation may cost several thousand dollars and no further stripping may be necessary for from three to five years. Consequently, it would not be fair to the first season's production to charge all the cost of this stripping but it should be pro-rated per ton of product over the term of from three to five years. This same principle would apply to the paying of freight and installation costs of machine. The subject of general expense charges is one that is difficult to handle in any business and especially in the pit and quarry business, and for these reasons it is frequently ignored.

In this article we are interested solely in the depreciation of plant and how bookkeeping should be done to show this depreciation. In starting a new development all the money expended is charged to the capital account and cross entries are made to the other accounts, the outline of which will be given. Two classes of buildings and structures are used in pits and quarries. The first are merely timber frames to support machinery and cheap board shacks. These

might be termed temporary structures and the life of such structures will seldom exceed five years. This is not due to the fact that they will be rotted in that time, but they are likely to be replaced with a more permanent set of buildings constructed mainly of steel and corrugated iron or of concrete and steel. These last named buildings will have a long life with but few repairs except to the roofs. With the first type of buildings the annual depreciation charge should be enough to charge it all off in five years. Some accountants charge 25 to 35 per cent off the first year claiming the greatest depreciation takes place in that year. They divide the rest of the depreciation evenly over the other four years. With more permanent type of buildings, the life will be considered twenty-five years or more so that the depreciation charge per annum will be only 3 or 4 per cent. For the building account there must be an expense account that should be known as repairs to building. If any new structures are built as the operation proceeds, they are charged to the building account.

When we come to consider the machinery and tools, we must have three major accounts. As already explained, one can be called plant or machinery. The word generally used is plant. These should all be items of fairly long life. Anything in the way of a small tool or machine that will last only a year or two or less should be charged under the head of tools. If a machine is small but has a fairly long life, it will be considered as plant. One method is to charge under the "plant account" all machines that can be counted upon to have a life of about ten years or more and to keep under "equipment account" all rolling stock and other equipment that is used for hauling or transporting materials. Thus if cars or locomotives are used in a quarry or sand pit, these are charged to an equipment account. The ties that are short lived may also be charged to this account while the rails of the track which should have a long life can be charged to plant account. Trucks and automobiles would naturally come under this account, for five years see most of these replaced and few, if any, automobiles are used for eight or ten years.

For each of these three major accounts there should be minor accounts of repairs and renewal. Although the tool account has been classed as a major account, it is in no sense a "capital account" but is simply an "expense account." It should be kept separate, for if the plant is sold or new capital becomes interested, there is a certain asset even in this account. The minor accounts can be separated, one for repairs and one for renewals. The difference in these has been explained. The renewal on tools is not a necessary account for the new tools are charged directly to the tool account. Thus for tools there is only the "tool account."

On all these investment accounts except tools there should be charged annually interest at 6 per cent and credited to an interest account; for all money invested in plant equipment, building, etc., should earn 6 per cent interest. Naturally as these decrease in value this interest charge is less. As an offset to these same accounts, there must be a depreciation account. As annual depreciation is charged against buildings, plant and equipment, it is credited to the "depreciation account." This depreciation account can be treated as a reserved fund or a sinking fund, and if business would permit, this amount of money could be set aside in a separate bank account. As old machines are either scrapped or sold, money would be at hand to make new purchases. By this method the original capital investment is kept intact, and money is always at hand to place wornout machines. However, few operators can afford to follow this practice so that they figure on paper that they have this money, it being only a paper credit. It is advisable to credit this account with interest at 6 per cent as this reserve or sinking fund should earn interest just as much as if money had been borrowed from the bank to meet running expenses.

The first consideration about plant is the equipment or the rolling stock. Where track is used, it is not safe to figure on ties for the track to last more than five years. Thus the depreciation on ties should be figured as 20 per cent. If treated ties were used, they would last longer. In many cases, however, ties are cut from timber that is on the tract of land that is being developed. Under ordinary uses, rail for the track should have a life of about 20 years. The wear on the rails from the cars is never excessive. The hardest uses they get is from shifting the track.

As already stated trucks and auto-

mobiles seldom have a life of over five years, and the greatest depreciation comes within the first year. Thus it would be advisable to charge off for depreciation for the first year 40 per cent and for the four additional years 15 per cent each. The experience to date has been that after three or four years' use it is better to trade in the old truck and obtain a new one rather than to continue the use of the old one with excessive repair bills and to suffer the many delays that breakdowns and repairs will cause.

The depreciation on cars has always been a little difficult to decide upon. The smaller cars especially in quarry work are pretty well used up in five years, but larger and heavier cars will last for ten years. There have been large cars used in quarries that have lasted even fifteen years and longer without excessive repairs, but this length of life is the exception rather than the rule. Under ordinary conditions the life of five or ten years should be used. It would be an injustice to the manufacturers of quarry cars to make this statement without adding that these figures are given on the experience of the past. Quarry cars are now being made much better so that in a few years we may be able to revise these figures. Until we gather more information on the subject the present estimate of the life of cars must stand.

Locomotives or dinkies for pulling cars are now of three types, namely, steam, gasoline and electric motors. The steam dinkies have had a life of from ten to twenty years. The gasoline and electric driven locomotives seem to have a shorter life, but with the improvements that are now being made on these they may be able to last longer. Thus any estimated life on locomotives is an average for the three types rather than an actual one for each type. The life figured on these machines is ten years, and at the present day this would seem reasonable.

The major plant account can be divided into two accounts. One could be the machines used in a quarry or a sand or gravel pit and the other of the machines used in the crushing plant or washing plant and other machines to produce products for sale. The machinery used in the pit or quarry will consist of drills, excavators, derricks, and hoisting engines, cranes and cableways. Drills are of three kinds, the small hand hammer drills, the tripod or percussion drills, and the deep blast hole or well drill. The hammer drills have a life of about five years while the tripod drills, if reasonable care is taken of them, will last much longer. If they are used continually, ten years is a fair life for them. There are tripod drills that are still in use that are much older than ten years, but in most cases these drills have been stored at different times for a number of years. The deep blast hole machines will generally last ten years, but during the last five years the cost of repairs and renewals is likely to be large, especially on gasoline driven machines.

The general type of excavator used in a quarry is a power shovel, and in most cases these are operated in quarries with steam although some are operated by gasoline motors and some are electrically driven. These power shovels are also used in sand and gravel pits. Here slack line cableways are also used for excavating, and the various types of wagon loaders are at times used especially in sand. The power shovels for sand and gravel are frequently of the revolving type and are the smaller sizes of shovels. Many of these are also used in handling the blasted rock in quarries, but in the larger quarries there are also some large sized power shovels. These large shovels are equipped with two yard dippers or larger and weigh sixty tons or more. The small size shovels working in sand and gravel can be counted on for life of twenty years, but the same size shovels working in rock should be figured for a life of only ten years. During the last two or three years the repairs on these shovels are likely to be heavy. The large size shovels that are used in quarries have a longer life often as long as twenty years.

Slack line cableways have been in use for about a decade, and there is little data at hand as to the life of these excavators. The original cost of these machines varies with the span of the cableway and the lay of the land. For the work they do the cost is comparatively small. The scrapers used are bound to wear gradually so that they will be replaced. This is also true of the cable but the hoisting engine will have a fairly long life. The towers may have to be moved or partially rebuilt so that it is difficult to give an exact life on the entire equipment, but with the

general knowledge we have regarding these machines, it is safe to figure their life at ten years.

Wagon loaders have also appeared on the market within the past decade. The early types of machines were lightly constructed and few of them lasted more than five years. However, those put on the market during the past five years have been vastly improved in their design and construction so it is safe to figure their life today as ten years.

Locomotive trains and other types of movable cranes and portable derricks are used quite extensively in sand and gravel pits and in quarries As a rule these machines are well built and their life can easily be figured at twenty years.

Derricks are used quite extensively in pits and quarries. The smaller sizes generally have timber masts and booms with the metal parts of heavy cast or wrought iron. The larger derricks are generally built of structural steel. The timber derricks have a life of about twenty years, while the steel derricks will last about twenty-five years. The hoisting engines that are used with these derricks can be figured for a life of twenty years.

In many pits and quarries pumps have to be used to keep them free of water, and in some sand pits pumps are used to excavate the sand. There are many sizes and types of pumps employed in these industries and of course, the wear and tear will vary with the service they must perform. This causes the upkeep on the pump to vary much in cost. Well constructed pumps that are given the proper care will have a long life, and generally speaking this is placed at twenty years. Unfortunately most operators do not give their pumps the proper care and allow them to become very dirty. The general idea seems to be to use some oil and let the pump work alone as long as it will keep going. For good service they should be kept clean, well lubricated with good packing in them. This means better service from the pump and a longer life.

At the crushing, washing and screening plant there are a number of different kinds of machines used. The first are those that furnish power for steam. These consist of boilers and engines, and here again the proper care of machines means a long life, while negligence results in cutting down the life of these machines considerably. There is a general impression among users of boilers that twenty years means that a boiler is unsafe for high pressures so that the life of boilers is generally figured for twenty years. However, many boilers have been used for a much longer period. Some boilers last twenty-five years and some even are serviceable for more than thirty-five years. These boilers have had excellent care and the firing of them was done with discretion. However, if twenty years is considered the life, the depreciation is charged off in that period of time, and if the boiler is used longer the operator is that much to the good.

The life of the ordinary stationary engine is considered as twenty years although light boilers have been used for a much longer time. Where electricity is made at the plant dynamoes are used in the power house and motors on the various machines. Of course, if outside power is used, only motors are employed at the plant. The life of dynamoes and motors is generally put down as twenty years.

Crushers are well built machines, and if given the proper care last for many years, but on account of their sturdy construction they are often neglected. For this reason many of the smaller sizes do not last more than ten years. The larger sizes of crushers can be counted on for a life of twenty years.

Screens should last as long as crushers, except the jackets. These have to be renewed from time to time and should be charged as renewals. The service on screens is quite hard as they not only carry a heavy weight but have a vibratory motion. One fault with them is that they are not set securely enough in place; and with the decided motion that they have, they wear out much more quickly than they should. There are continually being placed on the market improved types of screens so that the old ones are frequently discarded for a better type. Due to these reasons the life of screens is generally placed at ten years.

Elevators have about the same life as screens and this is also true of other types of conveyors that are used for sand, gravel and stones.

Washing machines have the same life as is generally ascribed to crushers. The smaller types will last ten

years and the large about twenty years. The repairs and renewals figure a larger proportional cost than they do on crushers.

The regular type of cableways with two towers is also used in these industries. Naturally they are built much heavier than the slack line cableways, and being used only for transportation and not for excavation last longer so that their life is put down as twenty years. Skips and buckets that are used with cableways, derricks, cranes, etc., have a life of about five years.

In regard to the depreciation on the buildings, many new developments start out with temporary structures. These mean the keeping down of the original capital invested, but due to their temporary nature and also to the danger from fire they should be replaced with more permanent structure. Where gravel and stone is produced, the permanent structures should be built of concrete or in quarries of stone masonry. With such structures, the annual depreciation except for the roof of the building should be very small. In many cases even the roof and floors can be built of concrete so that their upkeep and depreciation would be very little. It is not necesary to place a large number of buildings at one time, but from year to year new structures can be built in place of the temporary ones. In this way a heavy yearly depreciation can be eliminated and better still fire proof buildings can take the place of those that are easily destroyed by fire. This alone means much to an operator as fires are continually destroying plants throughout the country. When the proper type of buildings is used, the annual depreciation should only be two or three per cent while the repairs are not likely to exced the same amount. The only execption to this is the bins that are built to hold the products that are to be sold. The wear and tear on these is much greater than on any other structure, but with the new types of concrete bins properly lined with steel, their life should be twenty years.

It is a well known fact that if a machine is purchased and is not used, it can seldom be sold for the original purchase price. In other words, as soon as a machine gets in the hands of a customer even if it has not been used, it is considered second hand and in order to sell it, the price must be cut. Let a machine be used only a short while and in order to sell it a further reduction in price must be made although the machine may be just as good as new. Due to these facts some accountants prefer to charge for the first year's depreciation a larger sum than for the succeeding year. The usual charge under such a method is to make it double the average charge that is used annually. To illustrate, if the life of a machine is considered as twenty years, the average annual depreciation would be five per cent. Under this method the first year's depreciation would be charged as 10 per cent, and thereafter the depreciation charge would be figured at 4 6/10 per cent. If the life of a machine is ten years, the first year's charge would be twenty per cent and then for eight years nine per cent would be charged and for the last year eight per cent would be charged.

The outline given for handling the accounts of money invested in machines and their depreciation seemed in the past to be the logical one and it has generally been followed by those who figure this overhead cost of depreciation in their bookkeeping. The objection to it is that at the end of the year it is necessary to pick out the various items in the different accounts and apply the proper depreciation of each item. Thus in one account there may be items of plant that would have a twenty year life, others ten, while others would have only a five year life. To overcome this a different grouping can be made and various machines can be charged to accounts according to their life. Thus one account would have charged to it all machines that have a twenty year life. A second account would embrace all those that have a ten year life and so on through the list. Thus at the end of the year, it is easy to make a common charge against each account or group, and this gives the same result as the other method, unless a larger depreciation is charged for the first year than for the succeeding year.

There is one other method of figuring depreciation that is used by some accountants. In figuring depreciation as already discussed the yearly percentage is figured on the original cost. The second method is to figure this yearly percentage first on the original cost and then in the succeeding years on the depreciated value. Thus

if a machine costs $10,000 and was figured for a twenty year life, instead of charging $500.00 per year, this amount only would be charged the first year, and $475.00 the second year which would be five per cent of $9,500.00 while the third year the charge would be five per cent of $9,025 which would be $451.25.

This method would be continued throughout the life of the machine. Of course, instead of the account being closed at the end of twenty years, it would be continued as long as the machine was inuse for there would be some book value to the machine for a number of years longer than the stated period of twenty years.

It must be understood that in figuring depreciation the charges are not the real charges but arbitrary ones so that each accountant or operator will use his own judgment and follow his own ideas.

In figuring interest on money invested in machinery, if six per cent is to be figured, it can be done in two ways. The interest can be figured entirely on the original price of the machine. This will give the same results as in figuring it on the depreciated values of the machine and then figuring interest on the depreciation account. Although the results are the same, they are not as satisfactory as figuring it on depreciated values and then on the depreciation account. For this depreciation account is a reserved fund or sinking fund that should bear interest in order to have a credit on the books for replacing the machines as they are worn out. This is a better form of bookkeeping than the method of figuring it on the original cost of the machine, although it entails a little more work.

November Novo Power

The November issue of Novo Power tells in flaming colors the story of the excellent work done by a Novo engine at Galt, Ontario, during the worst fire in that city's history. It was a Model A F, four cylinder, 12 to 18 H.P. Industrial, and it pumped continuously without a stop from 11 o'clock P. M. Sunday, October 14, 1923, until about 11 o'clock Tuesday forenoon, October 16—just 36 hours without a stop.

The bulletin also reports other cases of extended non-stop service. With it is enclosed circular No. 272, telling "Why Novo Diaphragm Pumps Are Best."

American Road Builders' Association Meeting, Chicago, January 5 to 9, 1925

At the convention of the American Road Builders' Association, to be held at Chicago, January 5th to 9th, 1925, more spacious accommodations and a program which will discuss every angle of road construction and maintenance have been provided. A series of entertainments to take care of idle time has also been arranged. More than 200 applications for exhibiting space in the Coliseum and adjoining buildings have already been received from manufacturers of road building equipment.

The increased space at the management's disposal this year will make it possible to accommodate a greater number of exhibitors than in past years, and it is expected that by the time the allotment of space is made on November 10th, the previous record for total number of exhibitors will have been passed.

The convention program, prepared by Prof. T. R. Agg, long identified with road building in the United States, will include such speakers as A. H. Hinkle, Maintenance Engineer, Indianapolis Highway Department; W. H. Connell, Engineering Executive and Deputy Secretary of Highways for Pennsylvania; C. H. Connor, State Construction Engineer for North Caralina; Chas. M. Upham, Director, Advisory Board on Highway Research; Arthur H. Blanchard, Professor of Highway Engineering and Highway Transport; Prevost Hubbard, Chemical Engineer, The Asphalt Association; and Harry D. Robbins, Division Engineers, New Jersey State Highway Department.

The Road Show will again be in charge of C. M. Upham, Business Director, who will open headquarters at the Congress Hotel a month or so before the convention starts.

Gravel Company Changes

The Greenville Gravel Company of Greenville, Ohio, operators of half a dozen big gravel plants in Ohio, announces the resignation of Howard B. Hall as General Sales Manager. Pending reorganization of the Sales Department, matters heretofore handled with the Sales Manager will be taken care of by the General Management at Greenville, Ohio.

Census of Lime Manufacturers for 1923

THE Department of Commerce announces that according to reports for the biennial census of manufacturers, 1923, the establishments engaged primarily in the manufacture of lime products in that year reported a total output value at $47,243,756, an increase of 52.3 per cent as compared with $31,015,487 in 1921, the last preceding census year. The total production for 1923 comprised 2,510,283 tons of quicklime valued at $25,693,305; 1,255,562 tons of hydrated lime valued at $13,851,455, 2,926,725 tons of limestone sold as such, valued at $3,515,631; and miscellaneous products—crushed stone, round limestone, flux, etc.—to the value of $4,183,365.

Of the 333 establishments reporting for 1923, 68 were located in Pennsylvania, 33 in Virginia, 24 in Wisconsin, 22 in Ohio, 18 in Missouri, 14 in New York, 13 in Tennessee, 11 in Alabama, 10 each in Maryland and Massachusetts, 9 each in California, Illinois, Indiana, and Vermont, and the remaining 74 in 24 other states.

The statistics for 1923 and 1921 are summarized in the following statement. The figures for 1923 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

	1923	1921	Per cent of increase
Number of establishments	333	292	14.0
Wage earners (average number)	12,290	10,345	18.8
Maximum month	Aug. 13,341	Aug. 10,955	...
Minimum month	Jan. 10,604	Jan. 9,168	...
Per cent of maximum	79.5	83.4	...
Wages	$13,522,069	$ 9,801,651	38.0
Cost of materials (including fuel and containers)	$19,700,191	$14,214,205	38.6
Products, total value	$47,243,756	$31,015,487	52.3
Lime:			
Quicklime—			
Tons	2,510,283	1,665,109	50.8
Value	$25,693,305	$18,732,086	37.2
Hydrated lime—			
Tons	1,255,562	726,337	72.9
Value	$13,851,455	$ 7,489,707	84.9
Limestone, sold as such—			
Tons	2,926,725	2,425,372	20.7
Value	$ 3,515,631	$ 3,121,987	12.2
Other products—crushed stone, ground limestone, flux, etc., value	$ 4,183,365	$ 1,661,707	151.8
Value added by manufacture	$27,543,565	$16,801,282	63.9
Horsepower	74,263		
Coal consumed (tons of 2,000 lbs.)	965,210		

Notice of Removal

Announcement is made by Jean M. Allen & Co., engineers and contractors, formerly of 53 W. Jackson Boulevard, Chicago, of the removal of their offices to 841 Maison Blanche Building, New Orleans, La. It is also stated that this company has made arrangements with the Bates Engineering Works, 2270 Clybourn Avenue, Chicago, to continue the manufacture of their line of ladders, cutters, hoists and hydraulic dredge specialties. All inquiries for this equipment should be addressed to them.

Austin Company Removals

Various office removals are announced by The Austin Company of Cleveland. The Austin Company of California recently removed its San Francisco office to greatly enlarged quarters at 244 Kearny street. The headquarters staff of the Austin Company of California at Los Angeles also changed its address, moving into its new home at 777 East Washington street. This is a beautiful private office building, two stories high.

Greatly increased activity in the Bay District of California is reported by the Austin Company.

New Economical and Flexible Plant Producing Sand and Gravel

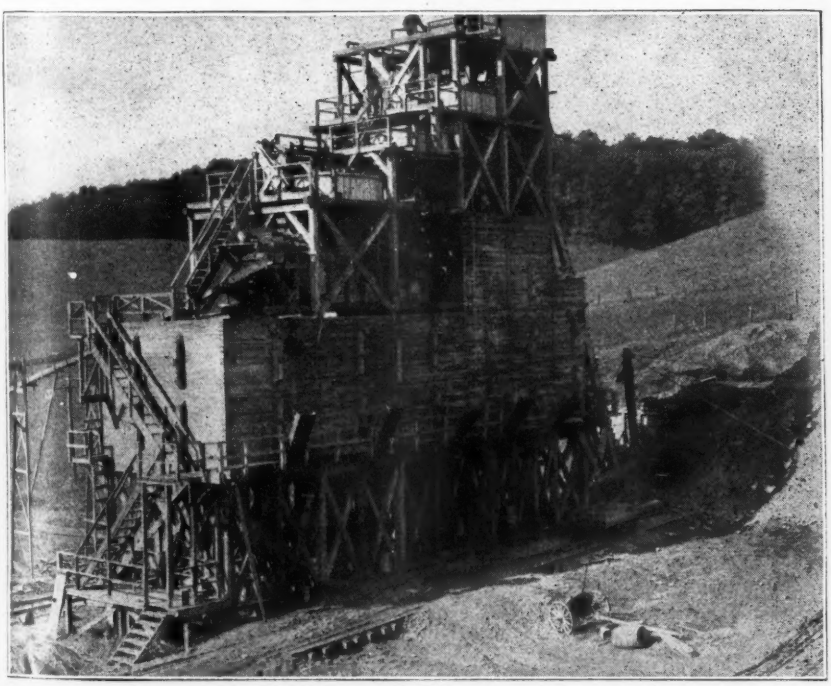
The Siler Springs Sand and Gravel Company Operating Plant Located Between Buffalo and Rochester, New York

THE Silver Springs Sand and Gravel Company is now operating its new plant at Silver Spring, New York, about half way between Buffalo and Rochester. Silver Springs, one of the most picturesque towns in Wyoming County, New York, is located on the Silver Lake Branch of the Buffalo, Rochester and Pittsburgh Railroad and the main line of the Erie Railroad. The company has its own siding from both sides of its bins connecting to the main line of the Erie, and they also have switching facilities to the Buffalo, Rochester and Pittsburgh Railroad.

The sand banks as far as they have been developed show the sand to be running 80 per cent and the gravel 20 per cent. Present operations are along a face about 50 feet giving a solid, clean, sharp, glacial sand. Small veins of gravel are evident. The capacity of the deposit has been estimated at 5,000,000 cubic yards.

The material is brought to a hopper by a Green bottomless scraper operated by a two drum Thomas hoist. The hoist is driven by a 100 H.P. motor. From the hopper the material is conveyed by a Stephens Adamson apron feeder to Stephens Adamson bucket elevators and then elevated 65 feet and discharged to a Stephens Adamson scrubber.

From the scrubber the material is carried by water and gravity into the first Gilbert rotary screen. The coarse gravel is removed by this screen and then the balance of the material passes to a second Gilbert screen where the medium gravel is separated. A third Gilbert screen



Front View of Bins Showing Double R. R. Siding.

North Side Bins and Office and Pump House.

A View of the Sand and Gravel Bank.

separates out the pea gravel and discharges the sand into a wash box. The sand from the wash box is conveyed by paddles to the bins or outside storage.

The bins have a combined storage capacity of 500 cubic yards. Additional storage is provided by using storage piles on either side of the bins. When the bins are filled or outside storage is preferred, the material is dumped by chutes through the bins onto the storage piles. The bins are equipped with quadrant gates and steel chutes on both sides. Cars can thus be loaded from both sides of the bins at the same time. The railroad siding from the main line of the Erie Railroad runs on both sides of the bins. With the switching facilities to the Buffalo, Rochester and Pittsburgh Railroad shipment can be made north, south, east and west.

Water is secured from large natural springs owned by the company. These springs are located nearby on ground as high as the tops of the bins. The water comes down in pipe lines by gravity to the pump pit. From this pit the water is pumped by a 40 H.P. Worthington centrifugal pump through a 6-inch iron pipe to the top of the bins a distance of 65 feet. From the top of the bins the water is distributed to the scrubber, screens and wash box by smaller pipe.

The plant is electrically operated throughout, there being a 100 H.P. motor on the hoist, a 40 H.P. motor on the screens and a 40-H.P. motor on the Worthington pump.

The present capacity of the plant is 500 tons per day. This is the capacity of the screens. The hoist, scraper, elevator, pump, etc. have a capacity of 1,000 tons a day. Provisions in the construction of the plant were made for another set of screens that will increase the plant capacity to 1,000 tons per day. Such an increase will probably be made this winter in anticipation of the spring demand.

The plant represents an economical layout that is sufficiently flexible to respond to any increase in demand for the product. Outside storage is practically unlimited and delivery to such storage is economical being by water and gravity. Loading from this storage will be by portable clam

Front of Bins Showing Bucket Elevator.

shell bucket. The location is such that shipments with reasonable freight rates can be made to Buffalo and to Rochester. There are numerous small towns and cities in this same district that will absorb considerable sand and gravel during 1925. It seems that there is already a market in excess of the plant capacity.

The Silver Springs Sand and Gravel Company incorporated under the laws of the State of New York with a capital stock of $150,000. The plant was constructed under the personal supervision of Mr. Gordon O. Spaulding who is vice-president and general manager of the company. The other officers of the company are Mr. W. M. Creveling of Mont Morris, President, and Mr. Willis M. Spaulding of Buffalo, Secretary and Treasurer.

Chicago Pneumatic Appointment

It is reported that H. E. Byer has been appointed Manager of Condenser and Vacuum Pump Sales by the Chicago Pneumatic Tool Company of New York, with headquarters in New York.

Shepard Electric Hoists

Floor Operated Electric Hoists is the title of a new illustrated descriptive Price List and Catalog issued by the Shepard Electric Crane & Hoist Co. of Montour Falls, N. Y.

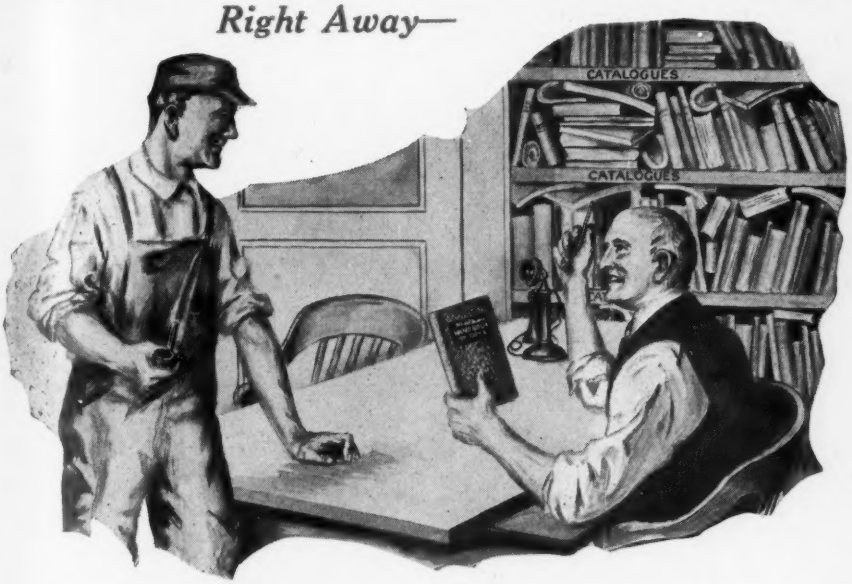
In past ages when muscle power was the common means for moving and lifting loads, world development was slow. In view of the great development that has accompanied the perfection of the means of transportation, it must be acknowledged, says the Shepard Company, that transportation is the foundation of progress.

There is no place in the modern business structure for any but the most efficient methods of material handling, for lifting and load-moving are the largest contributing factors to the actual production cost of nearly every article made.

This catalog contains the standard line of Shepard Electric Hoists, with descriptive information on mechanical details, adaptability and application of Shepard Hoists, and gives dimensions, prices and other data useful to the executive or engineer. It is illustrated with many half-tone engravings of individual hoists and installations and diagramatic drawings.

Loading Cars from West Side of Bins.

"Say Chief, We Must Have a New Conveyor Belt Right Away—



Got a catalogue on Conveyor Belting?"
"Yes, I suppose so, but why hunt it out—about all makes are catalogued in the HAND BOOK!"

Pit and Quarry HAND BOOK is serving, every day, hundreds of operators of pits, quarries, cement, gypsum and lime mills. It furnishes the answer to their technical questions that arise from day to day in operation of their plants.

And the Equipment Catalog Section describes the various items of machinery and supplies as cataloged by leading manufacturers in their lines. It helps them to decide what to buy and where to buy it.

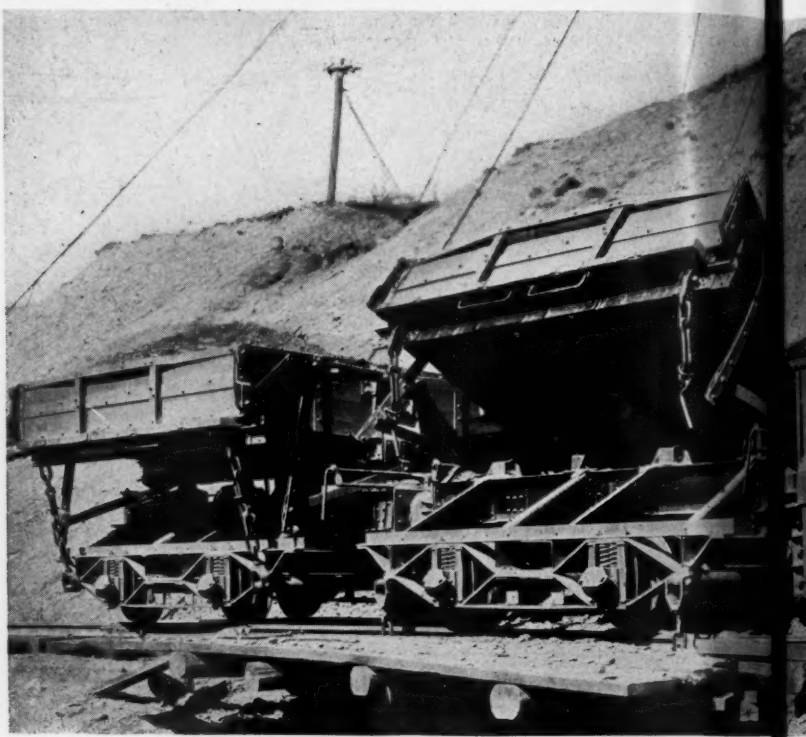
And every operator has the HAND BOOK, without cost.

That's why operators refer to it and THAT'S why manufacturers advertise in it.

Pit and Quarry

HAND BOOK

RAND-McNALLY BLDG., CHICAGO



J. E. Carroll Sand Co. Cho

The J. E. Carroll Sand Co. of Buffalo, has just completed a big, new sand and gravel plant at Franklinville, N. Y. The equipment is the last word in efficiency, and naturally Plymouth Locomotives were chosen to assume the haulage burden. Mr. Carroll writes:

"We have been users of Plymouth Gasoline Locomotives for the past eight years. They have given such good satisfaction that when we built our new Franklinville plant our first choice was naturally the Plymouth.

"Our men at the plant will always use the Plymouth in preference to another make we have had in use. That I

Gasoline PLYM

Plymouths for New Plant

consider the highest recommendation that can be given to anyone."

When a man buys, tries, repeats and recommends, his endorsement has WEIGHT. It can not be ignored or passed up as of no moment.

Write for Bulletins "C" and "F".

THE FATE-ROOT-HEATH COMPANY
Plymouth Locomotive Works
PLYMOUTH, OHIO

PLYMOUTH Locomotives

1910—*Fourteen Years of Service*—1924

Still handles 100 yards an hour

You want to know how much the crane you buy will handle as well as how much it costs. After all a crane's output, its years of dependable service and its resale value are what really determine its cost.

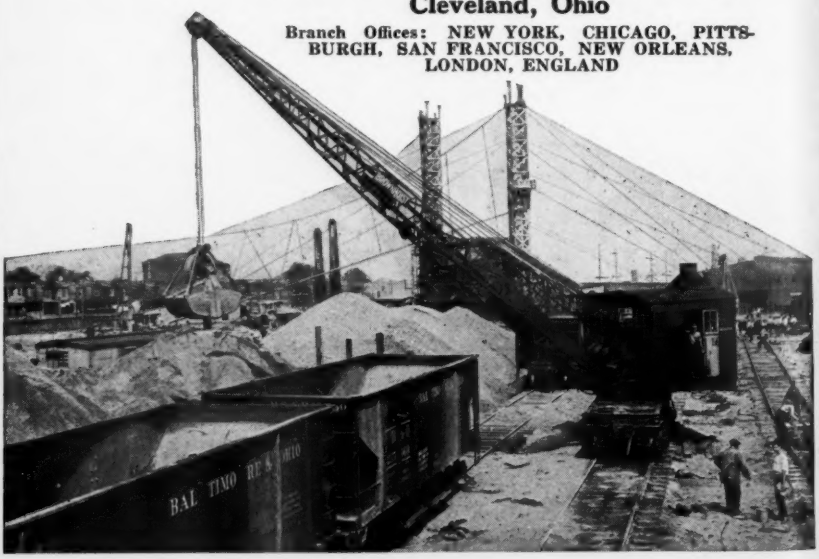
The Hunters Point Lumber & Supply Company of Long Island City offer an excellent example of Brownhoist crane value. Operating a fourteen-year-old crane with a one-yard bucket this company is unloading scows containing 550 to 600 yards in six hours. That this crane has paid for itself several times over is, of course, self evident.

The Brownhoist shown below is a 20-ton crane and a duplicate of one recently sold to the Hunters Point Lumber Co. as a result of the good work done by their old crane.

Catalog K shows all types of Brownhoist cranes at work, some on jobs similar to your own. *Write for a copy.*

The Brown Hoisting Machinery Co.
Cleveland, Ohio

Branch Offices: NEW YORK, CHICAGO, PITTSBURGH, SAN FRANCISCO, NEW ORLEANS, LONDON, ENGLAND



BROWNHOIST

MATERIAL HANDLING MACHINERY

The Economics of Rate Making

II.

Written Expressly for PIT AND QUARRY by JOSEPH H. DONNELL.*

This series of articles, the first of which appeared in the November 1st number of PIT AND QUARRY, will present a complete analysis of the economics of rate making. Heretofore information and data on this subject have been scattered and inadequate. The question of rates is a vital one to the producer and these articles will merit careful study. The first article discussed the elements affecting the carrier's cost of service.—*Editor.*

THE cost of railroad equipment is another element which materially affects the carriers' cost of performing service. The equipment and the cost thereof will vary with the nature of the commodities to be transported. Different commodities must move in different kinds of equipment. Lumber moves on flat cars. Coal moves in gondolas. Oil in tank cars. Dairy products, fruits, vegetables and dressed meat must move in refrigerators. Perishable commodities moving in the winter time must often move in heater cars to prevent freezing in transit. Ordinary live stock moves in live stock cars and high grade live stock such as race horses moves in what are known as palace horse cars, a very high grade equipment. There are other commodities such as grain, flour, and kindred products which must move in class A box cars due to their susceptibility to damage from the elements. Automobiles move in a special type of equipment. Automobile cars are much larger than an ordinary box car and cost more to construct.

Many commodities are not easily damaged and do not require any particular protection against the elements. They move in class B, C, or D box cars, which classes are used to respectively designate cars which are in good, fair and poor condition, insofar as maintenance or preservation is concerned. Class A cars used in the movement of grain and grain products are first class in every respect. The handling of a carload of dressed meat in a refrigerator car is more expensive to the carrier by reason of the higher grade of equipment used than would be the movement of a carload of lumber on a flat car, or a carload of coal in an open top car.

Joseph H. Donnell

A great many refrigerator cars are owned by shippers but where this is the case the carriers are required to pay mileage to the owner of the cars. The movement of certain liquids in tank cars is a large item of expense to the carriers for several reasons. In the first place a tank car is a special type of equipment and when used in the transportation of a commodity like oil must be continued in the service devoted to the transportation of that particular commodity. For example a carload of oil could not, upon being made empty, be used for the transportation of an edible product such as molasses or syrup. A particular movement of oil having been completed the car must be returned empty for another load or must be cleaned and thoroughly renovated before being made suitable for the transportation of some other commodity. In either event there is additional expense involved as the movement of the car empty to some other place to pick up a load involves considerable expense as well as the cleaning of the car in the event the car is used for transportation of some other commodity. The matter of hauling empty equipment very considerably affects the carriers' cost. For example, in a hearing before the Interstate Commerce Commission in a case brought by the National Petroleum Association against the M. K. & T.

*Traffic Counselor La Salle Extension University, Editor Trade and Transportation Bulletin, Formerly Member Rate Board of Swift & Co., General Traffic Manager, Stein, Hall & Co., and Rate Expert of Interstate Commerce Commission.

Railway 47 I. C. C. 355 Commission said, "Empty movement of tank cars used in Kansas, Oklahoma Oil traffic is practically 100 per cent of the loaded movement."

In connection with the initial construction cost of cars it may be said that a refrigerator car costs much more to construct than a box car. In a case involving the movement of fruits and vegetables 43 I. C. C. 291 the Commission said, "The cost of refrigerator cars of the latest type used on the Illinois Central Lines is about $1,600 as against $1,040 for a box car of similar size."

Car equipment varies in a number of different ways, in character, capacity and cost. A refrigerator car costs more to construct than a box car. A larger refrigerator car costs more to construct than a small refrigerator car. Further, the life of some cars is much longer than the life of other cars. For example, the life of a box car is usually longer than that of a refrigerator car. Another type of special equipment is used for the transportation of live poultry. In a case brought before the Interstate Commerce Commission which involved rates on dairy products 43 I. C. C. 700 the Commission said, "Live poultry moves in special poultry cars which cannot be used for any other traffic." A heavy empty return movement of poultry cars is necessitated by the fact that these cars must be used exclusively for the transportation of live poultry. Thus the empty return movement of equipment must be considered in estimating costs incident to the transportation of poultry. It may be accepted that the Commission not only recognizes that varying equipment cost affects rates and costs but is disposed to allow the carriers greater earnings where special equipment costs are involved. For example, in a case before the Commission brought by the Independent Ice, Feed and Fuel Co., against the S. P. L. A. & S. L. Railroad (44 I. C. C. 666) the Commission said, "A movement involving the use of box cars in single car lots and additional expense for special car protection and in cleaning the cars after use justifies a higher rate than where open cars are used in trainload lots, and no such additional expenses are necessitated."

The element of speed is also one that has a bearing on the carriers' costs. Many commodities must arrive at destination as soon as possible. The movement of hogs is very typical of this kind of commodity. The shipment of these animals especially in the summer time involves a very high mortality. They are loaded very closely in double deck cars and frequently at the end of the journey a number of them will be dead or in a greatly weakened condition. The consignee will of course have to dispose of the dead animals at a sacrifice as they must be used for purposes other than food. These low prices thus necessitated are reflected in claims against the carrier for such losses. These animals likewise have to be fed and watered in transit at regular intervals and caretakers must accompany the shipments. On account of this special service and the expense thereof, it is to the interest of the carrier to expedite delivery of hogs as much as possible thus reducing this extra expense as well as decreasing the possibilities of damage to the animals while in transit.

The element of speed also affects the cost of transporting articles moving under refrigeration. These articles which must be re-iced at intervals en route should move as quickly as possible in order to avoid the additional expense occasioned by re-icing.

The money invested in the carrier's plant and equipment is another factor which largely determines the measure of the carrier's costs. By money invested is meant the actual financial outlay for the physical properties including permanent improvements. In connection with this subject the Interstate Commerce Commission has said, "Present day rates should not be expected to earn a return on property costs inflated by inclusion of items not actually representing expenditures for road and equipment." Reference Rates for Transportation of Anthracite Coal 35 I. C. C. 220.

Until recent years the methods used in arriving at or estimating investment were varied and resulted in great confusion. There was little or no uniformity of practice and the Interstate Commerce Commission was thus required by act of Congress to establish a division of physical valuation. The purpose of this bureau was to accurately appraise the physical values of the railroads in this country. This work is still in progress and will doubtless continue for many years if indeed it may not be a permanent institution as valuations are constantly

subject to revision in order that carriers may continue to receive credit for monies invested in new improvements.

In the case of the Stonega Coke and Coal Company vs. the L. & N. Railway 39 I. C. C. 523 the Interstate Commerce Commission said, "A carrier cannot claim the right to earn a net profit from every mile, junction or other part into which its road may be divided." Thus in estimating the amount of money invested in any particular road, the road must be considered as a whole rather than in units or by various divisions of the road. In connection with the work of the valuation division of the I. C. C. the Commission said, "No hard and fast rule has yet been established for determining for all roads, fair value of the property." 33 I. C. C. 541. It is the object of the Commission to place a true value upon the actual monetary investment in the physical property used in transportation. In what is known as the Wabash Pittsburgh Terminal Investigation 48 I. C. C. 96 the Interstate Commerce Commission said, "This case illustrated the great need for control of security issues and emphasizes the wisdom of the Commission's requirement that the charges to the account reflecting the carrier's investment in roads and equipment shall be based upon the cash cost of the property." A few cardinal points upon which the Interstate Commerce Commission has laid emphasis and which the carriers must observe in valuing their property, follow. On the same principle that the actual value of permanent improvements may be included in the account the Commission has said that "In determining the value of a road, the depreciation actually accrued must be deducted." 33 I. C. C. 541.

Carriers' investments are of two kinds, permanent and temporary. A permanent investment may reasonably be expected during the course of a long number of years to bring returns to the carrier far in excess of the actual monetary investment. On the other hand a temporary investment may or may not prove to be a profitable investment for the carriers. To illustrate what is meant by a permanent investment as in contrast to a temporary one, let us assume that a carrier extends its line into a rich agricultural section. It may be assumed that the volume of tonnage derived from this territory will always be sufficient to yield the carrier a profitable return on the money invested. It is quite possible that as years pass the territory will become even more productive and more thickly settled thus resulting in an ever increasing flow of tonnage. This may be considered a permanent investment. On the other hand let us assume that a carrier extends its line into an oil producing territory and enjoys for a brief period a profitable flow of tonnage. However, assuming that the wells become dry and the flow of tonnage ceases it may be readily appreciated that the investment thereafter becomes a loss to the carrier. This may be considered a temporary investment by reason of the fact that is was incurred in order to enable the carrier to move a temporary flow of traffic.

Temporary investments are as a rule conducive to higher costs on the part of the carrier than permanent investments. It would seem only reasonable that carriers should enjoy higher rates in connection with a temporary investment than a permanent one in order to offset the higher cost incident thereto, and in this connection the Interstate Commerce Commission said in the Gold Field Cases 34 I. C. C. 360, "The investment being of a temporary character the rates over lines serving Tonopah and Gold Field are not necessarily unreasonable although higher than rates for like distances in other parts of the country."

Another feature incident to the correct estimate of a carrier's investment involves the acquisition by trunk line carriers of branch lines. Of this feature the Commission has said, "Great systems have acquired feeders and competitors at a cost higher or lower than construction cost and investment shown does not represent cost or approximate cost of property." Rates for transportation of anthracite coal 35 I. C. C. 220.

The true value of a branch line is not necessarily represented by the price paid for it by a trunk line. The actual purchase price may be far below or far in excess of the true value and hence the purchase price cannot be used as sole evidence of true valuation. In arriving at the true value of a carrier's property, incident to the determination of cost, reproduction cost may not be used as it is subject to fluctuation. The cost of reproducing a road today might be much less

than it would be six months hence and a year hence it might be much greater than the cost today.

In any event the Commission is in favor of the carriers earning an adequate return on their investment. In a case involving passenger fares (41 I. C. C. 584) the Commission said, "The railway company has not only recognized rights to earn a fair return on the value of its property but the interest of the public demands that the carriers shall receive revenue which will enable them to keep their equipment in good repair and maintain efficient service." The conclusion to be drawn from the foregoing is that carriers are entitled to a fair return on their investment but that their investment costs shall be actual rather than inflated.

Distance is another element which figures prominently in determining the carrier's costs. Costs for transportation over short distances are proportionately higher than for long distances. The element of distance however is one which like other elements must be considered in connection with other principles of rate making. In and of itself it is seldom a determining factor. Rates based upon distance alone would often be very undesirable as they would have the tendency to localize business and prevent long haul competition. Rates based upon rigid mileage scales would practically do away with long haul traffic. They would prevent manufacturers located at Chicago from competing with St. Louis manufacturers in the New Orleans market. Likewise, if the element of distance alone were determining, New York shippers could not compete on the Pacific Coast with those located in Chicago and Kansas City. However, the fact that costs for short hauls are proportionately greater than for long hauls, may be reflected in the rates. In a case brought against the D. L. & W. Railroad by Hopkins, Hough and Marrill Company (46 I. C. C. 427) the Commission said, "The rates for a short haul may well be proportionately higher than for long hauls but where the rates for less than two miles over a delivering line are more than one-third of the rate for 88 miles over the originating line the disparity could be warranted only under unusual circumstances and conditions." Thus the element of distance in connection with cost and rates must be employed within reasonable bounds. We can readily understand why short haul costs are higher than long haul costs when we consider that the carrier must furnish the same amount of equipment to take care of a short haul transportation service as for a long one notwithstanding the fact that its compensation for hauling the shipment for the shorter distance is less than for a longer distance. Hence there is an increase in cost incident to the service performed.

Another element which affects costs is the number of lines participating in a haul. Usually a two line haul is more expensive than a one line haul and the cost of handling a shipment via three lines would be even greater than via two lines. One reason for this is the frequent transfers of traffic which must be made in many joint hauls, thus involving extra handling of the shipment. It must also be considered that each line participating in a haul must have a record of the shipments which it handles. This involves more additional clerical expense in connection with shipments moving over two or more lines than in connection with shipments moving over one line. Further, each line involved in the haul of a shipment has a certain amount of expense incident thereto over and above which it may reasonably be expected to make a profit. Naturally, the greater the number of roads participating in a haul the greater the minimum expense incident thereto hence the greater the necessity for higher rates to insure a profit to all of the roads involved. To illustrate the attitude that the Interstate Commerce Commission has taken in regard to this question, it may be mentioned that in the case of the Northwestern Cooperage and Lumber Company vs. the Minneapolis, St. Paul and Ste. St. Marie Railway (43 I. C. C. C. 629) the Commission said, "The rate for a two line haul may properly be higher than the rate for a one line haul." The Commission also said in the case brought before it by the Independent Ice, Feed and Fuel Company vs. San Pedro, Los Angeles and Salt Lake Railroad (44 I. C. C. 666) "Ordinarily the rate for a one line haul should be lower than the rate over a three line route."

The expense incident to the loading and unloading of shipments also has a very material influence on the carrier's cost. For this reason the costs

in connection with carload shipments are materially less than in connection with less than carload shipments. Carload freight is usually loaded by the shipper on his private siding and unloaded by consignee. L. C. L. freight is usually teamed to the carrier's freight house where it must be loaded into the cars by the carrier's employes and unloaded at desination by the carrier's employes into the freight house of the railroad. There are times however, when a shipper will avail himself of the use of trap cars, thus relieving the carrier of the expense of loading less than carload freight. In these cases where a carrier furnishes a car for the loading of L. C. L. freight it is stipulated that a minimum weight of from 6,000 to 10,000 pounds shall apply in connection therewith. The shipper will load many L. C. L. shipments into a car and the car will be pulled from the shipper's side track to a transfer house where bulk is broken and the L. C. L. shipments are distributed to the various lines, thence to be hauled to the several destinations. The economy reflected in the loading of these L. C. L. as well as carload shipments by the shipper is conducive to lower costs on the part of the carrier, and in connection with carload traffic is conducive likewise to lower rates.

Direction of the movement is also an element affecting costs and rates. As a general rule rates applying between two points should be the same in both directions. Especially is this true of class rates. However, where a commodity rate applies in one direction and a class rate in the other, it may reasonably be expected that the commodity rate will be lower and under ordinary conditions properly so because there is usually some very good reason for the establishment of a specific commodity rate. It is quite possible that the volume of traffic moving in the direction that the class rate applies is not sufficiently great to justify the establishment of a commodity rate, whereas the volume of traffic in the reverse direction is quite heavy and commodity rates are therefore appropriate. If commodity rates were established promiscuously regardless of the volume of traffic, there would soon cease to be any class rates. This would soon result in the carriers having to shrink their earnings to such an extent as to seriously impair their revenues. This would be especially true in the case of less than carload freight. On the question of differing rates in opposite directions the Commission has said "With substantially similar transportation conditions affecting rates in opposite directions between the same points there should be no material disparity in rates." West Virginia Rail Company vs. B. & O. Railroad (50 I. C. C. 318). It will be noted in this decision that the Commission stipulated that the conditions should be substantially similar in order to justify a parity of rates in both directions. Again, the Commission said, in a case brought before it by the Producers Sales Company against the New York, New Haven & Hartford Railroad (48 I. C. C. 438), "Differing rates in opposite directions over the same line require explanation." The Commission also said, "The rates in one direction are not always a fair test of what the rates should be between the same points in the opposite direction." Merchants Freight Bureau of Little Rock vs. M. T. Railroad (50 I. C. C. 248).

Argument for and Against the Cost of Service Principle

Arguments have been presented by various parties before the Commission both for and against the consideration of cost of service in the construction of rates. Some of the reasons why cost of service should be considered are as follows: The cost factor is one of great importance in almost every business, and must necessarily be in order that a fair return may be realized. While the railroad business is in many respects different from the ordinary commercial industry, nevertheless it is also in many respects similar to commercial industries and the carriers must make their revenues exceed costs in order to realize a profit. This is true not only because of the importance of the welfare of the railroad but because of the welfare of the public generally which depends in large measures upon the prosperity of the railroads and their ability to efficiently operate. It is also true that many persons are dependent upon the railroads for their livelihood. This not only includes railroad investors but railroad employes, and employes of railway supply companies. It has been variously estimated that one out of every fifteen persons in the United States is either directly or indirectly dependent upon the railroad for his

or her livelihood. Rates based upon the cost of service may be said to be favorable to shippers in that they are conducive to the earning of a fair return by the carriers thus enabling them to perform efficient service for the shipper. In the long run a prosperous carrier is in a position to furnish cheaper transportation and better transportation than a carrier in financial straits.

As for the arguments opposed to the consideration of cost of service as an element of rate making it may be said that there is no argument for the complete abandonment of this principle. There are, however, reasons why the cost of service should not be considered the sole factor of rate making. While cost of service may be disregarded in some measure in the establishment of individual rates yet this principle cannot be entirely discarded because of the disastrous effect that such a course would have upon the carriers' revenues.

It has been argued that it is a very difficult matter to determine the exact cost and that this is one reason why the cost of service should not carry a great deal of weight. While it is true that it is almost impossible to determine with any great degree of accuracy the exact costs incident to the handling of individual commodities, nevertheless they may be approximated and in connection with the handling of all traffic via a certain railroad the cost may be determined with a fair degree of accuracy. As stated in the previous chapter this difficulty of determining costs is due to the fact that all costs are "joint," that is, they comprise capital charges and fluctuating operating expenses.

Cost of service used alone as a determinant of rates would often result in unreasonable rates, rates too high on low grade commodities and too low on high grade commodities. In many cases the rates thus arrived at would be greater than the traffic could bear and would have the effect of retarding and in some cases entirely stopping the traffic. Some expressions from the Interstate Commerce Commission will be very helpful in arriving at an opinion as to the correct relative weight to be attached to the cost of service principle.

Regarding the movement of bituminus coal in C. F. A. Territory (46 I. C. C. 66) the Interstate Commerce Commission said, "The cost of transporting a commodity is an element properly to be considered in deciding what is a reasonable rate, but it is not necessarily determinative in all cases. Of course, the transportation may be said to determine the minimum rates that may be charged as on the other hand the value of the service to the shipper marks the maximum of a reasonable rate of charge." In another case which involves the movement of anthracite coal (35 I. C. C. 220) the Commission said, "Costs do not determine rates. Most rates have within them as a constituent the element of cost. Cost is generally an important element in arriving at a judgment with respect to a rate."

Again, the Commission said, "Each class of service should bear reasonable charges therefore having due regard to cost and value thereof determined in light of other pertinent considerations." Western Passenger Fares (37 I. C. C. 142).

The cost of service principle of rate making may be said to have taken on an added importance in the last few years. During and immediately following the war the carriers' costs of performing service ascended very rapidly due to the higher prices of commodities necessary to the maintenance of the transportation company's properties and the high wage scale. Congress recognizing these higher costs passed the Transportation Act in 1920, in which it authorized the Interstate Commerce Commission to allow the carriers to establish rates which would as nearly as possible allow a net return of from 5½ to 6 per cent upon the aggregate value of their properties. This was a direct recognition by Congress and by the Interstate Commerce Commission of the cost element as an important one incident to the establishment of freight rates. It should be borne in mind however, that rates can never be predicated or based upon one factor alone. Sound economy will always necessitate the consideration of all elements and factors affecting the movement of any particular commodity all of which considerations and circumstances will have to be taken into consideration in the establishment of freight rates.

Value of Service

As cost of service is the minimum level of rates, value of service may be said to be the maximum level of rates, as rates which exceed the value

of service would exceed an amount that the shipper can afford to pay. They would be more than the traffic would bear. To disregard the value of service would result in inequitable rates, and would ultimately tend to decrease the flow of tonnage. This would not only result in an ultimate depletion of the carrier's revenues but would be bad for business in general. The views of the Interstate Commerce Commission with regard to this element of rate making may be gleaned from the following excerpts from decisions. "The value of the service is entitled to be considered in rate making." Reference National Hay Association vs. Michigan Central Railroad (19 I. C. C. 34). "The value of the service has a more or less definite relation to the rates." Reference Memphis Cotton Oil Company vs. Illinois Central Railroad (I. C. C. 313). "When fare expenses are covered by the rate and an increase would kill the traffic commercial necessity may make the rate the best paying one on the commodity which the carrier can obtain." Western Rate Case (35 I. C. C. 497). "The value of the service to the shipper is not conclusive as to the reasonableness of the rate exactions." Wulff Produce Company vs. Pennsylvania Railroad (14 I. C. C. 170). "The reasonableness or unreasonableness of the rate does not depend exclusively upon shippers' ability profitably to market their products." Riddle vs. M. C. & St. L. Railway (37 I.C.C. 602). From these decisions a number of conclusions may be drawn. First, the Interstate Commerce Commission recognizes that the value of service to the shipper is an element which may properly be considered in rate making. It must of course be considered in conjunction with other elements and conditions which have a bearing. Second, the Commission recognizes that the carriers in establishing their rates on a particular commodity must do so bearing in mind that rates established must not exceed what the commodity can afford to pay. Otherwise the flow of traffic would be retarded. Revenue obtained might not be as much as the carriers would desire but under the circumstances it would be the most obtainable and therefore to the interest of the carriers to accept it. This however may not be construed to mean that rates shall be made unreasonably low merely in order to enable the shipper to make a profit. Finally, it may be concluded that the value of service principle alone is not to be used as the sole determining factor of rate making. Similarly, what the traffic will bear cannot constitute the sole consideration upon which rates will be based.

In analyzing the value of service it may in itself be said to constitute the added value of the commodity due to transportation. Two points should be borne in mind. First, notwithstanding the fact that in some cases the value of service to the shipper may be negligible, rates should not be unreasonably low considered in the light of the cost of service. Second, rates should not be so high as to deprive shippers of a legitimate profit, on the sale of their products. The ability of a shipper to make a profit however may not be considered as a determinant of the reasonableness or unreasonableness of rates. That is, it is a point to which consideration should be given but not a determining factor. On this point the Commission has said, "Complainant shows that his shipments have practically ceased since rates assailed became effective, but we have frequently held that the reasonableness or unreasonableness of the rate does not depend exclusively upon shippers' ability profitably to market their products." Riddle vs. M. C. & St. L. Railway (37 I.C.C. 602). Again, the Commission said, "Reasonableness of rates on low grade commodities is not to be gauged by the ability or inability of shippers to market their products with profit." Nashville Car Company vs. L. & N. Railroad Company (40 I.C.C. 377).

Another interesting decision of the Interstate Commerce Commission rendered in connection with this point is contained in the so-called Iron Ore Rate Cases (41 I.C.C. 181) in which the Commission said, "Each shipper is entitled to have his freight transported at reasonable rates and each carrier is entitled to charge a reasonable rate on the commodity transported and any method of rate making that results in subordination of these basic principles to the equalization of manufacturing costs through the adjustment of freight rates on raw material cannot be sanctioned." Consideration of the value added to a commodity by reason of transportation is perhaps the most practicable method of determining

what the value of service may be. In determining value of service by this method the increased value should be based upon the destination market value and not upon cost of ingredients, raw material, or cost of production. As illustrative of this, let us assume that two commodities are more or less similar and because of this similarity involve approximately the same manufacturing costs. One of these commodities however may be widely used and commands a broad market, the other being more or less restricted in use and commanding a relatively small volume of sales. The former by reason of its popularity of demand may command a market price of $50.00 per 100 pounds, while the latter commodity because of a limited demand may bring only as much as $25.00 per 100 pounds or less. The sale of equal quantities of these two commodities will naturally result in a larger profit to the seller of the higher priced commodity than to the seller of the low priced commodity. Consequently the value of the transportation service performed incident to marketing the two products will be greater to the former than to the latter. The more costly commodity from the standpoint of value of service can therefore stand a higher rate than the less valuable one.

Professor Hammond in his book on "Railway Rate Theories of the Interstate Commerce Commission" cites a very appropriate illustration of this situation. He says, "A manufacturer of patent medicine made objections to the Official Classification employed on eastern railway lines according to which patent medicine was placed in first class when shipped in less than carload lots and in third class when shipped in carload lots, while beer, ale, etc. when shipped in less than carload quantities were given a third class rating and in carload lots were placed in fifth class. The complainant asserted that not only were the modes of packing, the methods of handling and the risks of transportation the same with the patent medicine as with the beer, ale, etc. but that the intrinsic value of the patent medicine was no greater than that of the beer, etc." The Commission however declared that "the value of an article to the manufacturer is the price it commands and it seems only reasonable that carriers should take into account the market value, it being generally known and easily ascertained, as one of the considerations in arranging their classification and fixing the rates that commodities should bear. It is not seen how the relation that any specific commodity should bear to other commodities for classification purposes can be arrived at in any other practicable way." Professor Hammond's comment upon this decision is, "Since the evidence in this case showed that a carload of the patent medicine in question had a market value of $5,400 while a carload of beer, or ale sold for about $1,800 the Commission decided that the existing difference in the classification and rates was justified."

In short, the value of the service to the patent medicine dealer in this case is greater than to the shipper of ale and beer. Had both of these shippers been unable to secure transportation of their products to the market the shipper of the patent medicine would have had more to lose than the shipper of the beer. It will also be seen in this connection that the value of service is closely related to the value of the commodity. Nothing in the previous decision must be construed as permitting a railroad to establish unreasonably low rates in order to permit a shipper to make a profit from the sale of his commodity. It must be assumed that the carrier could make a profit upon the transportation of the lower graded of the two commodities. The amount of the shipper's profit in each case however enables the carrier to establish a proper relationship between rates on different commodities.

In basing rates upon the value of service it is not always necessary for the carriers to compare service values of different commodities. A commodity may frequently be considered independently of other commodities. For example, the market value of an article at point of origin we will assume to be $5.00 whereas at destination it is $6.00. This higher price at destination may be due to a more favorable market, however in order to enjoy this higher price the commodity must be transferred to the point of delivery thus the transportation service performed has added $1.00 to the value of the article and this may reasonably be considered the value of the service.

Rates based upon the value of service may be compared with an in-

come tax schedule based to a large extent upon what the income will stand. It is in this sense that the term "what the traffic will bear" is most frequently used. Commodities of a low grade usually bring low prices and should therefore be transported at low freight rates as it is highly improbable that the margin of profit in connection with the sale thereof would justify a higher rate or permit the payment of a higher rate.

Freight rates may also vary with the stage of manufacture of an article. For example, pig iron, sheet iron, wire and watch springs are all from iron ore and yet the value of each of these commodities is different. Iron ore is the least expensive of the five commodities, pig iron being the next higher in value, sheet iron is even more valuable than pig iron and wire is more valuable still but it may be said that watch springs would probably compare in value with iron ore in about the same manner that a diamond would compare in value with a lot of coal. With each stage of manufacture the value of the commodity increases, similarly its capacity to stand a higher freight rate increases. A practical illustration of this fact is contained in a case which was heard before the Interstate Commerce Commission involving rates on straw from St. Louis to Atchison, Indiana (36 I.C.C. 30) in which the Commission said: "A ton of strawboard is worth four times the value of a ton of baled straw." The Commission also said in another case "Low rates on certain commodities are usually based on low value of the product rather than the reasonableness of the rates themselves. Rates on low grade oil prescribed." Reference: Mid-Continent Oil Rate (36 I.C.C. 109).

It is quite apparent that strawboard can afford to pay higher rates than baled straw due to its higher value. We can also readily understand why a low grade of oil should move on lower freight rates than a high grade of oil as the former cannot afford to pay as high a rate as the latter. In addition to this the element of risk is higher in the case of highly valued articles than in the case of cheaper articles. The carrier's liability is greater in connection with the former than in the latter. In the case of the Iowa State Board of Railway Commissioners vs. A.T. & S.F. Railway (36 I.C.C. 79) the Commission said, "The value of service has substantial bearing upon the reasonableness of rates graded according to value."

It must be remembered that value of service although an important factor of rate making is not the sole determining factor and must be considered in connection with other elements such as cost of service, competition, risk, volume of tonnage, etc. Thus the Commission said in the case of the Hydraulic Pressed Brick Company vs. the Pennsylvania Company (43 I.C.C. 369), "Brick is desirable traffic from the standpoint of loading, density, value, risk, volume and other considerations which tend to determine the reasonableness of rates and should be accorded low rates in comparing with most other traffic." In a case involving the transportation of silk, a very high grade commodity, the Commission said, "Silk is one of the commodities of the highest value in proportion to the ratio which the charges bear to the value of the commodity." Reference Pennsylvania Railroad (44 I.C.C. 578). It is safe to say that the Interstate Commerce Commission if called upon to prescribe rates on brick and silk would prescribe lower rates on brick than upon silk and its decision would be based largely upon the fact that the value of brick and consequently the value of service in connection with its transportation is much less than the value of silk and the value to the shipper of having the silk transported. The use of the value of service principle in rate making is economically just. It cannot be used exclusively but should be used in conjunction with other factors such as the cost of service in order that all conditions incident to the transportation of a commodity may receive due consideration when rates upon that commodity are to be established. The value of service principle serves a very useful purpose in facilitating correct judgment as to the measure of rates suitable to different commodities, as for example, low rates on low grade commodities and high rates on high grade commodities.

Volume of Movement

The volume in which any specific commodity moves has a decided bearing upon the rates which shall be applied. The volume of movement tends in large measure to determine what other principles shall figure in the establishment of rates and to just what extent they shall be considered.

Thus in the establishment of a specific commodity rate the correct relative weight which attaches to the value of service principle as in contrast to the cost of service principle will probably be determined by the volume of the traffic. This is principally due to the fact that the cost of service is so greatly affected by the volume of traffic.

In a case brought before the Commission by the Utah-Idaho Grain Association vs. D. & R.G. Railroad (44 I.C.C. 714) the Commission said, "Considering the reasonableness of the rate on a certain product its volume should be considered." The Commission in another case said, "Density of tonnage is a factor to be considered in questions affecting the adjustment of rates." Reference Eastern Fruit Growers' Association vs. B. & O. Railroad Company (33 I.C.C. 343).

Lumber and grain are two commodities which move in large volume and of the former the Commission has said. "Increase in density of traffic points rather to decrease than to increase rates and tends to sustain reasonableness of present rates." Reference Lumber Rates from Points in Arkansas (34 I.C.C. 102). Of grain the Commission said, "The rates on grain and grain products from producing points in the west to the Atlantic Seaboard should be relatively low because of the large volume of the traffic." Reference Grain from Manitowoc, Wisconsin (37 I.C.C. 549).

Thus it may be seen that a heavy volume of traffic which tends to result in lower costs likewise justifies lower rates. A heavy volume or density of traffic likewise serves to insure lower general rate levels than would be possible in connection with a light volume of traffic. Rates in some territories are lower than in other territories, due to varying degree of traffic density. The Commission has said, "The Commission has recognized the propriety of higher level of rates in a territory of low density of traffic than should prevail in a territory of high density of traffic." The Iron and Steel Cases (36 I.C.C. 86). A striking example of the truth of these statements may be seen in the fact that the general level of rates in Official Classification Territory is much lower than in either Western or Southern Territory. This is due to the greater density of population in Official Classification and the consequent density of traffic resulting therefrom. What is true of the volume of traffic is also true in large measure of the density of loading in connection with individual shipments. For example, two shipments are offered to a carrier for transportation, the first one weighing 40,000 lbs. and the second one 60,000 pounds. The railroad cost for equipment in connection with the heavier load is no greater than in connection with the lighter load, one car being sufficient for either shipment, likewise one locomotive. Assuming that both shipments involve the transportation of the same commodity between the same points the revenue of the carrier on the heavier load is 50 per cent greater than on the light one and as the railroad has no greater equipment cost in connection with the heavier load than in connection with the light one its profits on the transportation are naturally greater in connection with the heavier shipment. It should also be considered that the cost of hauling two cars of freight is relatively less than the cost of hauling one car, as for a single car a locomotive must be furnished. Having furnished the locomotive the carrier with no additional expense for motive power could as easily haul two cars as one.

While it is true that lower rates may be established for carload shipments than for less than carload shipments, it is not true that rates may be established for the movement of trainload lots. To establish lower rates for trainload lots than for single car lots would be to work a discrimination in favor of the larger shipper against the smaller shipper whose limited volume of sales would preclude the possibility of his shipping in trainload lots.

In this connection the Commission has said, "The mere fact that certain traffic is hauled in trainload lots cannot be made the basis of rates different from those applied to shipments in single carloads. This is upon the theory that to permit the practice would be in effect to allow lower rates upon a condition which only a few shippers can comply with and would do an injustice to those unable to ship the required quantities." Reference Wells Lumber Company vs. C.M. & St. P. Railway Company, (38 I.C.C. 464). In the case of the Diamond Lumber Company vs. C.M. & St. P. Railroad (43 I.C.C.), the Commission also said, "The Commission has never approved

a tariff provision applicable to trainload lots."

The heavy loading of commodities promotes the maximum use of the carriers car equipment and results in corresponding decreases in the railroads costs which are reflected in its rates. When the railroad furnishes a car to a shipper for loading, its revenue in connection with the transportation of the shipment will vary proportionately with the weight of the shipment.

In the chapter dealing with the cost of service, it was shown how less than carload freight is conducive to higher transportation costs than are incurred in connection with the handling of carload freight. It should again be mentioned here that for the reasons already stated less than carload rates are higher than rates on carload shipments notwithstanding which fact less carload freight is ordinarily considered unremunerative traffic for the railroads.

In Farar vs. Southern Railway (11 I.C.C. 632) the Commission said, "In regions of lumber supply the amount of this class of freight offered for transportation is very large and the shipments continuous and regular. The tonnage is of vast importance to the carriers affording them a principal source of revenue. The immense volume alone of traffic is an argument for not only reasonable but comparatively low rates and these in turn are necessary to the exploitation of the lumber industry in new fields that partake of the character of pioneer development."

It will be noted that the Commission not only mentions the large volume of traffic but its continuity and regularity. Unquestionably the regularity of traffic is conducive to lower costs on the part of the carrier and conversely irregularity of traffic is provocation of high costs. In view of the very close relation existing between the volume of traffic and the regularity of movement it is proper to here consider just to what extent the regularity of a movement will contribute to the measure of the rates thereon.

In the first place regularity of movement tends to permit the railroad to secure maximum utilization of its equipment. The carriers lower costs by reason of such economies should be reflected in freight rates. For example, the movement of lumber is not only large in volume but fairly regular. By reason of this regularity the railroads may calculate with a fair degree of accuracy the approximate tonnage which will move from a given territory within a stipulated period.

They are thus enabled to allocate to that territory a sufficient number of cars to adequately handle the tonnage without waste of equipment. If more cars were placed than were needed it is quite probable that the superfluous cars would remain idle for a long period and would result in a loss to the carriers of returns on the capital invested in the cars. As a further illustration of the effect of the regularity of movement upon the railroad's cost of performing service, let us consider another illustration. Assume that a grain company is located in the yards of one of the large trunk lines at Chicago. It daily car requirements are supplied by the carrier upon whose rail it is located. The capacity of the elevator is 25 cars per day and sales contracts are such that 25 cars are shipped every day in the week. The carrier serving this industry knows that 25 cars will be required every day, no more and no less. By reason of this knowledge it is enabled to place exactly the right number of cars required for outbound loading. Now if due to irregularity of operation this grain dealer would ship five cars Monday, 35 cars Tuesday, 15 cars Wednesday, 18 cars Thursday and the outbound tonnage of various other shippers located in the vicinity varied in a similar manner from day to day it may readily be seen that the carrier in order to take care of the requirements of these shippers would be forced to allocate to this district the maximum number of cars required on any day, when on many days far less than this number would actually be used. This would result in the needless detention of a lot of cars which could in many cases be used to good advantage elsewhere and would actually result in the carriers having to own and maintain a vastly greater number of cars than would be actually necessary for the needs of its patrons. Naturally, this higher cost would have a tendency to result in higher rates.

If there is any doubt as to the effect of volume and regularity of movement upon the carriers' cost one has but to remember that the carriers maintain large soliciting or sales forces for the solicitation of freight or the sale of transportation. Certainly

it would not pay them to maintain these expensive business getting facilities unless the results were beneficial. In speaking of the density of traffic Professor William Z. Ripley in his book "Railroads, Rates and Regulation" says "The most important single factor in the production of increasing returns upon a railroad is the density of traffic, that is to say, the amount of business which can be conducted with a given set of rails, terminals and rolling stock. In other words, it is a degree of effective utilization of the plant and equipment. It is too obvious to need demonstration as to what has been set forth concerning the nature of railroad expenditures that economy of operation and consequently the profits are more or less dependent upon this fact." To illustrate the effect of volume and regularity of traffic upon rates let us consider the conditions incident to the actual movement of a few specific commodities. Of low grade commodities coal is fairly typical. It moves in large volume and with great regularity. Coal moves in heavy volume all the year around although greater quantities move in the winter than in the summer. The rates on coal are low as compared with other commodities for these reasons.

Flour is a necessity and a commodity which moves in large volume. It also moves throughout the entire year and therefore rates upon flour are relatively low.

The rates upon needles in comparison with the rates on coal and flour are extraordinarily high. They are not used to anywhere near the extent that coal and flour are used. Needles are a high grade commodity, very light in weight, and seldom if ever move in carload lots. These are some of the reasons why the rates on needles are high.

Cork is a commodity which by reason of its inherent nature necessitates comparatively high rates. It is very light in weight and requires great quantities to equal any cosiderable weight. It can be readily seen that inasmuch as rates are assessed on this commodity in units of cents per 100 pounds that the rates must of necessity be relatively high. What is true of cork is especially true of cork in shapes.

The question of minimum weights applicable on carload shipments is one closely related to the volume of movement and to the density of loading. Commodities of low grade moving in large quantities usually are subject to high minimum weights. On the other hand high grade commodities moving in small quantities are usually subject to low minimum weights. The Commission in a number of cases has expressed its opinion as to the proper measure of minimum weights in connection with various commodities. It has said, "Carriers are under obligation to establish and maintain reasonable minimum weights for carload shipments and when lawfully published the prescribed minimum is as much an integral part of the tariff as is the rate. Both must be strictly observed by carriers and shippers alike and the Commission can set aside neither except upon satisfactory proof of the unreasonableness thereof." Reference: Unreported Opinion No. 392.

"There are greater car earnings under a lower rate with a higher minimum than under a higher rate with a lower minimum." Reference Wool, Hides and Pelts (25 I.C.C. 151). Again, the Commission said, "An increased loading which results in decreased cost of transportation may well justify a lower rate for a higher minimum." Reference (23 I.C.C. 151). In a case brought before the Commission by Montague & Company against the Santa Fe Railway (17 I.C.C. 72) the Commission said, "It is in the interest of economical transportation that cars containing light and bulky articles should be loaded as heavily as possible and it is equally plain that a carrier can afford to an extent to decrease its rates in proportion as the loading increases."

In the case of the Georgia Fruit Exchange vs. the Southern Railway Company (20 I. C. C. 623) the Commission said, "The minimum carload weight is a factor in the carload rate and in connection with the rate per 100 pounds determines the carload earnings. Any reduction in the minimum weight without increase in the rate per 100 pounds would therefore reduce the carload earnings of the carrier and would be equivalent to a reduction in the rate itself." It is plainly to be seen that a large volume of traffic and heavy loading is conducive to low costs and therefore exercises a distinct tendency to lower rates. Conversely light loading and a small volume of traffic tend to increase rates.

Hazelton Stone and Sand Company Reducing Sandstone to Sand

Plant at Youngstown Ohio Producing 400 Tons Daily Very Good Example of Sandstone Property and Plant

THE property and plant of the Hazelton Stone and Sand Company of Youngstown, Ohio, are a very good example of a plant reducing sandstone to sand. The deposit covers nine acres in the heart of Youngstown. This deposit is a good grade of impure sandstone containing large percentages of quartz, feldspar and mica. It is a reddish brown in color due to the presence of ferris oxide. This ferris oxide forms thin coatings around each quartz grain. There is also a little mixture of clay in this sandstone. This clay averages from three to five per cent.

The deposit is being worked for a double purpose. The compact sandstone is cut for building purposes and also for millstones and grindstones. The material is also crushed for use in making concrete and roads. The sandstone is very hard and durable and makes excellent material for roads. In the building stone probably its main objection is that it is very hard to work. The cut stone at the plant showed that the deposit had been greatly consolidated by pressure and it appeared able to withstand much weathering. The mica in this sandstone deposit facilitates splitting along bedding planes.

The sandstone is blasted loose by Grasselli powder. This constitutes the main break. Deep hole and block hole drilling is done with Ingersoll Rand jackhammers. Plugs and feathers are used for breaking the blocks loose. A McKierman air compressor supplies the air for the drills. After the blocks are loose they are lowered to the yard by a hoist and derrick operated by a National hoist engine. The blocks are then split into the needed sizes and stocked. The waste and scrap which is considerable is then loaded into quarry cars. A 50 foot ledge is being worked at present.

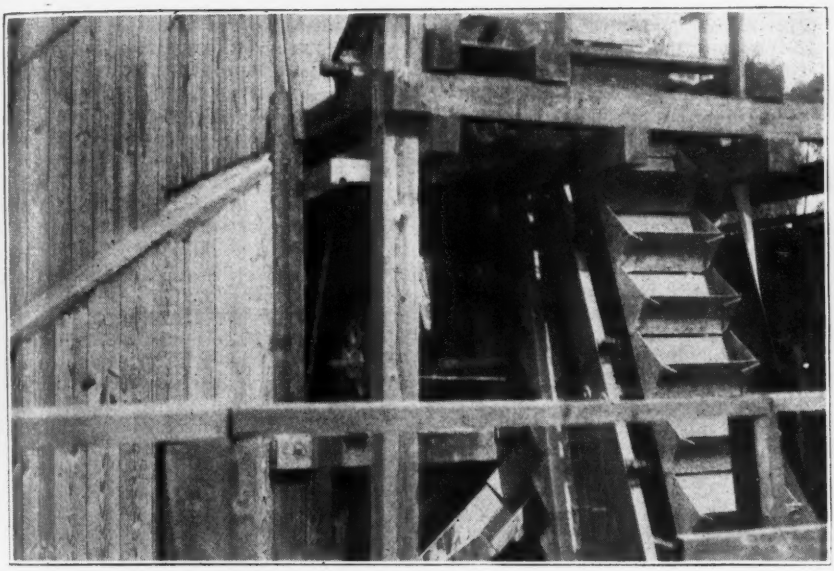
These quarry cars are hauled up an incline by another National hoist and

A View of One Face of the Quarry.

View Showing Quarry and Incline, The Crusher.

dumped into a number 20 Champion crusher. The discharge from this crusher is hoisted by a Champion bucket elevator 32 foot centers to a 51-inch Sturtevant rotating screen 16 feet long. The buckets on the elevator lifting to this screen are 24x12x8 inches. The rejects from this screen are dropped into a steel hopper which feeds to a 16-inch endless belt conveyor that discharges into a Sturtevant roll mill. There are two balanced rolls one 20x15 and the other 30x16 inches. Before going to the rolls the stone passes a Dings Magnetic separator which removes all

View Showing Storage Bins and Bucket Elevator.

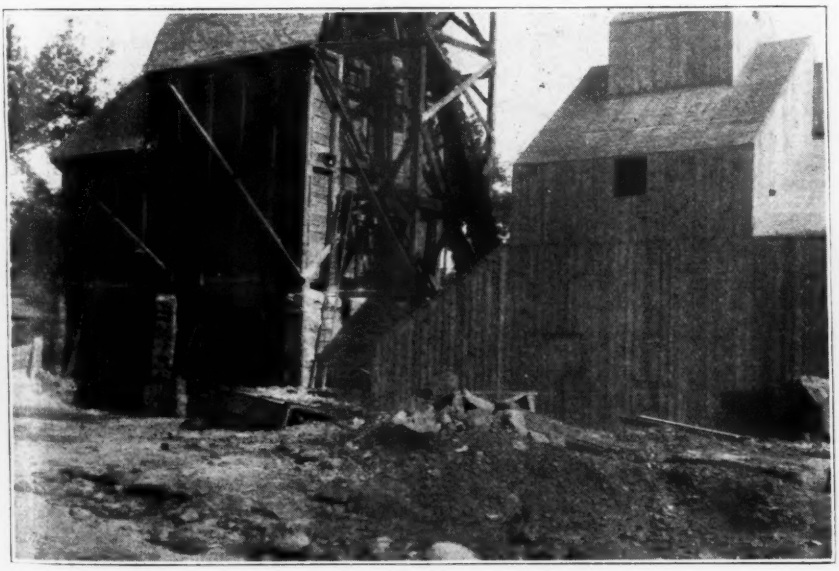


The Bucket Elevator to Rotary Screen.

tramp iron bolts, etc. The magnetic separator is very essential as a safeguard to the rolls. From the rolls the material is elevated by a Sturtevant continuous bucket elevator to a Sturtevant moto vibro screen.

The rejects from the vibro screen are conveyed to a hopper by a continuous belt conveyor. From this hopper the material is fed to a second set of Sturtevant rolls.

The material passing the first screen which is the 51-inch rotating screen is discharged into the vibro screen. All material must pass through this vibro screen.



View of Crushing House and Storage Bins.

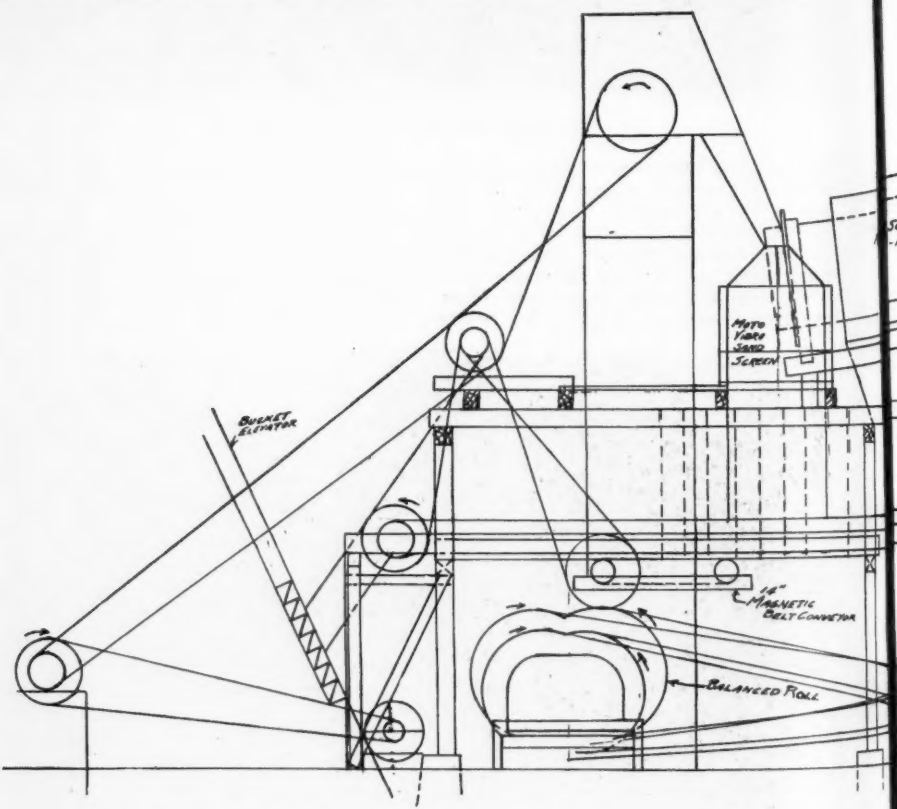
The vibro screen discharges onto a 16-inch belt conveyor which in turn discharges to an endless bucket elevator 54 foot centers that elevates the material to storage. There are two storage bins with a combined capacity of 600 tons.

All the motors at the plant are General Electric. A 75 H.P. motor drives the crusher, bucket elevator to the rotating screen and the rotating screen itself. The bucket elevator to storage and the feed belts to this elevator are driven with a 20 H.P. motor. The rolls are driven by a 40 H.P. motor. The hoist for hauling cars up the incline is being operated by a 15 H.P. motor.

There is no siding into the plant and for shipments made by railroad it is necessary to haul by truck several blocks to the railroad. However the bulk of the output is delivered by truck. The trucks are loaded directly under the bins and weighed on Fairbanks-Morse track scales before leaving the plant.

An Erie 250 H.P. boiler is used in the power plant and a McKierman air compressor is also housed in the power plant.

The Hazelton Stone and Sand Company was incorporated in 1919 under the name of the Hazelton Operating Company and the name later changed. Mr. Fred Hohlock is president. Mr. William Kersecker is vice-president. Mr. E. J. Kane is treasurer. Mr. Thomas Vesy is secretary and Mr. Francis Vesy is assistant manager.



Layout of the Crush[illegible]nt, Ha

Barber-Greene Equipment

You Have Paid for Barber-Greene Equipment — Did You Get The Machine? is the title of a new folder issued by The Barber-Greene Company of 9 So. Clinton St., Chicago.

"The cost of unloading and storing by hand a season's tonnage of coal," says this bulletin, "will pay for Barber-Greene equipment. If you have enough work to keep labor-saving machines busy *you pay for them whether you get them or not.* You pay in wages to laborers."

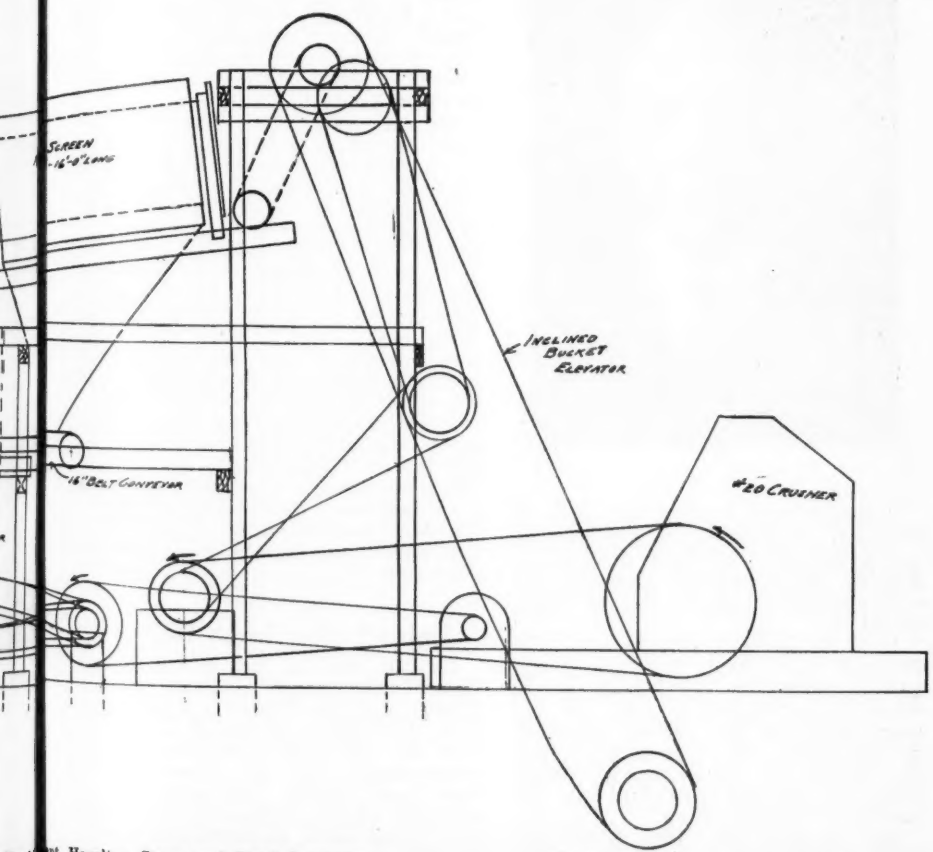
The bulletin illustrates two typical cases of the use of Barber-Greene equipment, resulting in increased business and lowered handling costs. The bulletin is illustrated with cuts of the machines in use.

"Dracco" Pneumatic Installation

Bulletin No. 505, (Revised) has been issued by The Dust Recovering & Conveying Company of Cleveland, Ohio. The bulletin describes, with elaborate illustration, the "Dracco" Pneumatic Conveying Installation, Conveying Lithophone in Chemical Plant.

The illustrations show a photograph of Collecting Station and Pump; Plan View and Side Elevation with Conveying Distances; Pump and Collecting Station, with Principal Dimensions; Material intake under Crusher; and Material as Handled.

The Dracco System for Pneumatic Conveying and high efficiency Dust Collecting, they say, is the result of much research and experimenting.



Crush[illegible]nt, Hazelton Stone and Sand Company.

Lime and Cement Man Elected Senator

AT the election on November 4, Kentucky electors chose Fred M. Sackett of Louisville as United States Senator from Kentucky, with a popular majority of over 20,000, a post which Mr. Sackett accepted as an honor and an opportunity to serve his city and state, and the South. Mr. Sackett is vice president of the J. B. Speed Company, jobbers of building materials such as lime and cement, and vice president of the Louisville Cement Company, manufacturers of cement and lime. The latter company also operates big quarries which produce not only rock from which the company products are made, but also commercial crushed rock, screenings, etc.

Fred M. Sackett

Although Mr. Sackett was born in the east, Louisville gave her adopted son a majority of 10,000 over A. O. Stanley, Democrat, now Senator, and a former Governor, as well as representative.

Fred M. Sackett came to Louisville 25 years ago. He is 55 years of age and a native of Providence, R. I., where he graduated at law. In the years following Mr. Sackett practiced at Columbus and Cincinnati, Ohio, and finally at Louisville, Kentucky. Later he became president of the Louisville Gas Company.

Mr. Sackett has had wide and varied experience in both the legal and business worlds. He served three terms as president of the Louisville Board of Trade, and later during the war, was Federal Food Administrator for Kentucky at a dollar a year, and was instrumental in securing Camp Taylor for Louisville during the early days of the war, arranging for the purchase of much of the land at his own risk in order to guarantee the War Department necessary acreage.

He is director of the Louisville Industrial Foundation, the million-dollar fund for bringing industries to Louisville; president of the Black Star Coal Company; president of the Pioneer Coal Company; and vice president of the North Jellica Coal Company in eastern Kentucky; vice president of the Beaver Dam Coal Company of western Kentucky; president of the wholesale and retail coal house of Byrne and Speed Coal Company, Louisville; vice president of the Speed Realty Company; director of the Fidelity and Columbia Trust Company and director of the Federal Reserve Bank.

He may have a few more titles, at that, but these will suffice, says our correspondent, who adds that he will make an ideal senator because of his combination of legal, business, and financial experience, and with his great wealth will not be forced to "wear any man's collar." Until now Mr. Sackett has never run for office, although he has been active in Republican party work. When his name was suggested for Senator he was not interested, but finally agreed to run if nominated.

Press dispatches from Washington on November 5, stated that Republican leaders in the Senate are already planning for his appointment to the Appropriations Committee, where his business and financial qualifications will make him especially valuable to the party.

Dolan-Tucker-Smith Bulletin

Bulletin No. 11, just issued by the Dolan-Tucker-Smith Equipment & Supply Co., 53 West Jackson Boulevard, Chicago, is a list of Construction and Railway Equipment which the company has for sale. This is used and rebuilt equipment. The company buys, rebuilds and sells cars, track rails, locomotives, cranes, shovels, and drag-lines.

Calcined Dolomite in the Recovery of Gold and Silver

By E. S. LEAVER[1], C. W. DAVIS[2], and J. A. WOOLF[3]

CALCINED dolomite has recently been sold as a substitute for lime in cyaniding gold and silver ores; the calcine being cheaper per ton than lime. It has been usually believed that the magnesia content of commercial lime has no practical value in the cyanide process. Julian and Smart state that magnesia may be used in place of lime, but a larger quantity is required. In order to understand the facts recorded in the following pages, it should be remembered that magnesia is practically insoluble as compared to lime.

Lime in the Cyanide Process

In cyanide work, lime is used for two purposes, (1) to prevent loss of cyanide, and (2) to cause precipitation of undesirable substances, and flocculation and settling of ore slime. The primary object is to increase the extraction of precious metals.

Lime prevents loss of cyanide in several ways. It neutralizes acidity, thus tending to prevent the formation of HCN, and reacts with any HCN formed (especially during precipitation of gold and silver), preventing its escape. Lime also combines with carbonic acid and other substances which would otherwise consume cyanide, and replaces cyanide in compounds which have already formed, liberating cyanide to usefulness. A large excess of lime, however, has been found to increase the cyanide consumption over that resulting when less lime is used.

Lime precipitates some substances which would interfere in the cyanide process, causes coagulation, and promotes the settling of slimes.

If the precious metals are combined with or mechanically held within certain base minerals not attacked by a cyanide solution, the presence of lime may cause a reaction with mineral and thus permit the dissolution of the gold and silver.

A high alkalinity due to excess lime in solution, however, usually decreases the rate of solution of gold and silver. This in the case of soluble sulphides may be due to the reducing action and to the removing of oxygen that is necessary for dissolution of the precious metals.

Calcined Dolomite in Preventing Cyanide Loss

For neutralizing acidity, theoretically MgO should be weight for weight, more efficient than CaO in the ratio of 28 to 20. In a practical test magnesia was found to be three times more effective than lime for neutralizing mine waters for use in cyaniding, where a solution containing 0.05% H_2SO_4 was passed through calcined magnesia (⅛ to ¼ inches in diameter) at the rate of 3.5 liters per hour. The resulting solution was slightly alkaline.

MgO reacts with CO_2 and with SO_2, giving a slightly alkaline solution. Since MgO readily reacts with HCN to form $Mg(CN)_2$ a good solvent for gold and silver, an excess of magnesia should be suitable for preventing loss of free cyanide.

Our laboratory tests show that magnesia added to dilute solutions of ferrous and ferric sulphates readily reacts, causing precipitation of iron salts. The resultant solution is slightly alkaline. This indicates that magnesia is as efficient as lime in combining with many substances that consume cyanide. In practice the iron salts should be oxidized to forms that would not react with cyanide.

Although magnesia may be efficient in preventing loss of cyanide, it may react to form soluble magnesium salts, and in the absence of lime a saturated solution of magnesium salts may result if the solution be used repeatedly for treating new batches of ore. A few tests showed that a saturated solution of magnesium sulphate caused a cyanide loss as high as 18 pounds per ton in clean solutions, and this loss would, of course, be excessive in practice.

If an excess of CaO, either as lime or as calcined dolomite, be added to a

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solution containing magnesium sulphate, magnesium hydroxide, and calcium sulphate are formed. These salts, being practically insoluble, are eliminated from solution. A series of experiments using different amounts of magnesium sulphate together with an excess of either lime or calcined dolomite showed no excessive cyanide loss, thus confirming the use of CaO as a corrective for presence of excessive magnesium sulphate.

In using calcined dolomite to neutralize acidity most of the CaO would react first, the MgO content would then react to neutralize further acidity.

The reactions may be expressed as follows:

$2H_2SO_4+Ca(OH)_2=CaSO_4+2H_2O+H_2SO_4$

$H_2SO_4+Mg(OH)_2=MgSO_4+2H_2O$

The "protective alkalinity" would be low due to the slight solubility of magnesia in cyanide solutions; however, with certain ores low alkalinity is desirable.

Elimination of Magnesium Sulphate

If more calcined dolomite be added to the solution a further reaction takes place: $MgSO_4+Ca(OH)_2+MS(OH)_2$

This shows that the MgO content of calcined dolomite is effective in neutralizing acidity, but is detrimental when the solution is to be used continuously for treating fresh batches of ore (by causing soluble magnesium salts to build up in solution), unless enough excess calcine is present for its CaO content to react with these soluble salts. In the latter case as much CaO is required to precipitate magnesium hydroxide as would be necessary to neutralize acidity in the first place.

A series of tests was made in which a cyanide solution was used several times to treat new batches of ore, there being added to each batch a quantity of magnesium sulphate equivalent to 60 pounds per ton of ore, and an excess of calcined dolomite. The silver was removed from the solutions by zinc dust after each extraction. Cyanide was added in such quantities that the concentration was kept about 4 pounds of KCN per ton of solution. The cyanide consumption was normal and the solutions were free from magnesium salts, showing that excess calcined dolomite is effective in preventing cyanide loss and in preventing soluble magnesium salts from building up when a solution is used several times for treating ore containing cyanicides and soluble magnesium salts.

Protective Alkalinity

All our tests confirm usual practice, in that the loss of cyanide is considerable when no alkaline compound is present but is greatly reduced by adding the proper quantity of protective agent.

The results of the experiments showing the relation of cyanide consumption, or loss, to the kind of alkali used, indicate that for each ore there is a quantity of lime for which the cyanide loss is at a minimum and that large deviations from this optimum in either direction will increase cyanide consumption. In this favorable range calcined dolomite or magnesia, although their "protective alkalinity" (slight solubility) is less, have about the same value as lime for preventing cyanide loss. Where an insufficient amount of protective agent is added, lime is perhaps slightly more effective than an equal weight of calcined dolomite, but if there is a considerable excess of alkali present the excess calcined dolomite does not consume as much cyanide as an equal weight of lime. This suggests that the excess of CaO (which is relatively quite soluble) may be detrimental, while the calcined dolomite, having less CaO than an equal weight of lime, consumes less cyanide.

Whenever a large excess of alkaline agent is used the "protective alkalinity" is as great with calcined dolomite as with lime, since there is sufficient CaO in the calcined dolomite to give a saturated solution of calcium hydrate.

In tests where the ore had been treated with SO_2 previous to cyanide extraction, the calcined dolomite seems to be superior to lime which in turn is more effective than NaOH in preventing cyanide loss.

Calcined Dolomite in Settling Slime

Julian and Smart have shown that it requires 748 grams of magnesia to cause the same settling effect as 654 grams of lime, indicating that for certain ores lime may be more economical than calcined dolomite as a settling agent.

Some of our experiments show that magnesia is satisfactory for settling slimes from cyanide solutions, but that the following wash with water causes conditions to change so that settling is very slow.

Tests with other ores indicated that calcined dolomite has about the same coagulating and settling effect as lime, except that in some instances the solid matter does not settle as compactly. In a few tests the settling effect of calcined dolomite was more lasting than that of lime, but since impurities, fineness, method of burning and method of hydrating have a great influence, these tests are not conclusive.

Filtration and Precipitation

It has been suggested that if calcined dolomite be used instead of lime in the cyanide process, magnesium salts would build up in solution and cause difficulty in filtration and in zinc precipitation. We have shown previously that the presence of excess calcined dolomite prevents the accumulation of soluble magnesium salts, but that magnesium hydroxide is formed as an insoluble bulky precipitate which might retard filtration. In order to determine the effect of soluble magnesium salts and the presence of precipitated magnesium hydroxide on the rate of filtration a Buchner funnel was fitted with a heavy canvas disk as a filter medium and attached to a suction flask which in turn was connected to a manometer and an aspirator. The vacuum was kept constant at about 24.5 inches of mercury for all tests. It was found that the time of filtration in the test where magnesium sulphate had been added to its saturation point, was about the same as that of the sample to which no magnesium sulphate had been added. These results indicate that magnesium salts should not cause difficulty in filtration.

When zinc dust was used to precipitate silver from pregnant solutions saturated with magnesium sulphate no trouble was encountered.

Extraction

It has been shown that, for the ores tested, when optimum amounts of alkaline agent are used calcined dolomite is as effective as lime in preventing cyanide loss and causing settlement of slimes. If calcined dolomite has no more detrimental effect than lime on the plant processes, a point which would have to be tested at the plant, the suitability of the former as a substitute for lime in the treatment of ores can be determined from the value of the precious metals extracted and the cost of the alkaline agents used in the two cases.

The results given in the accompanying table indicate that for the ores tested, the extraction of gold was slightly better with magnesia than with either lime or calcined dolomite, and that the gold recovery was the same for lime and calcined dolomite.

Two series of tests were made to show the effect of magnesium sulphate on the extraction of silver from an ore. In the first series the cyanide solution was saturated with magnesium sulphate and the same solution used to extract three batches of ore, the silver being precipitated with zinc and fresh sodium cyanide added after each test. The extraction of silver was very poor and the results rather erratic. This was probably partly due to the fact that since the cyanide loss was great it was difficult to keep sufficient cyanide present to effect solution of the silver. This shows that if a solution became saturated with magnesium sulphate negative results are to be expected. In the second series a cyanide solution was used repeatedly to extract three batches of ore, to each of which epsom salt equivalent to 60 pounds per ton had been added. Excess calcined dolomite was used in each test and as in the previous series the silver was removed by zinc dust and fresh cyanide added after each extraction. A check was run in which no magnesium sulphate was used. This series shows that the presence of excess calcined dolomite prevents cyanide loss from a solution originally containing magnesium sulphate, but that the extraction of silver from an ore by cold solutions is lowered by the presence of magnesium sulphate.

A number of tests were made on five different ores (results on four of them are given in the table), approximating plant practice, in which the effect of lime and calcined dolomite was compared.

Summary

The results of our experiments indicate the following:

(a) In regular cyanide practice where cyanide solution is to be used repeatedly for extracting fresh batches of ore, the MgO content of calcined dolomite can not be used advantageously to neutralize acidity.

(1) Where an excess of calcined dolomite is used to prevent the building up of magnesium salts in solution, the MgO content takes no part in the reaction.

(2) If just enough calcined dolomite is used to neutralize acidity, magnesium salts will build up and eventually form a saturated solution in which the cyanide loss would be high unless an unusual amount of "bleeder" solution is run to waste.

(b) In the cyanide treatment of certain ores calcined dolomite may be substituted for lime with profit.

(1) Calcined dolomite is as effective as lime in preventing cyanide loss.

(2) Calcined dolomite nearly parallels lime in its precipitating and settling effect and causes no difficulty in filtration of the solution, or in the precipitation of silver by zinc.

(3) Calcined dolomite equals lime in the quantity of precious metals recovered.

(c) In treating certain ores by the cyanide process, the recovery of silver with the use of calcined dolomite as an alkaline agent is not equal to that obtained with the use of lime.

(d) The use of MgO content of calcined dolomite would therefore be confined to neutralizing acidity and aiding settlement where the ore is crushed in water for amalgamation prior to cyanide treatment and in cyanide practice where the solution could be discarded or "bled" sufficiently to keep down excess of magnesium salts.

A summary of all our tests indicates that under proper operating conditions the recovery of silver is about the same with calcined dolomite as with lime.

Foote Brothers Standard Gears

A Price List of Standard Gears, No. 12B, has been issued by Foote Brothers Gear and Machine Company of Chicago. This pocket size hand book contains 384 pages, and is the twelfth edition of the catalogue issued by this concern.

The first edition of the IXL catalogue, as stated in the preface, was issued in 1895, and "contained price list and valuable information tables, was the pioneer in the field of gears, and the only book of its kind issued at that time. In this, the 12th edition, we have given more time, labor and expense in its compilation than ever and are therefore presenting a book of more comprehensiveness and of greater value to the Engineer, Designer, Mechanic or Buyer than any previous issue."

The greater part of the book consists of tables of weights, measurements, and prices, illustrated at intervals with engravings and drawings. The book also contains illustrations of plant departments, Spur Gear Speed Transformers and parts, gas and coal furnaces and the like. The steady and increasing demand for IXL products, they say, has again caused them to enlarge their plant and capacity, and the company is far better equipped than before to execute all orders received.

The Bristol Co., Waterbury, Conn., has issued Bulletin 330, describing the new Bristol Indicating High Resistance Pyrometer Model 420.

CYANIDE TESTS COMPARING THE EFFECT OF LIME, CALCINED DOLOMITE AND MAGNESIA.

Test No.	Ore Tested	Protective Agent Kind	Protective Agent Lb. per Ton of Ore	Protective Alkalinity in Lb. CaO per Ton in Solution	Cyanide Consumption Lb. KCN per Ton of Ore	% Recovery Silver	% Recovery Gold
1	Comstock	None	None	None	7.170	79.2	93.4
2	Comstock	MgO	13	Trace	1.295	80.2	93.8
3	Comstock	Calc. D.	13	0.18	1.280	82.5	93.4
4	Comstock	CaO	13	0.28	1.006	83.7	93.6
5	Comstock	Calc. D.	20	0.44	0.915	76.5	93.5
6	Comstock	CaO	20	1.40	0.915	79.9	92.7
7	Tonopah Ex.	None	None	0.10	6.08	93.0	94.5
8	Tonopah Ex.	MgO	8	0.50	3.08	94.3	95.0
9	Tonopah Ex.	Calc. D.	8	0.76	3.06	88.2	94.8
10	Tonopah Ex.	CaO	8	1.06	3.08	87.9	94.4
11	Tonopah Ex.	Calc. D.	20	1.84	3.57	93.0	96.1
12	Tonopah Ex.	CaO	20	2.20	3.60	94.4	96.2
13	West End	Calc. D.	5	0.36	3.96	94.8	92.7
14	West End	CaO	5	0.56	3.60	92.8	92.9
15	West End	Calc. D.	10	0.52	4.44	93.6	93.1
16	West End	CaO	10	1.04	4.20	94.0	92.5
17	West End	Calc. D.	20	1.12	3.95	93.8	92.6
18	West End	CaO	20	1.80	4.13	93.9	92.6
19	West End	Calc. D.	30	1.88	4.32	94.2	93.3
20	West End	CaO	30	2.02	4.32	93.9	93.1
21	Rochester	Calc. D.	20	0.72	3.81	73.3	82.1
22	Rochester	CaO	20	1.00	4.05	75.4	83.2
23	Rochester	Calc. D.	30	1.15	4.05	73.5	82.5
24	Rochester	CaO	30	1.40	4.05	78.4	82 9

The Berkshire Gravel Company Operating New Plant

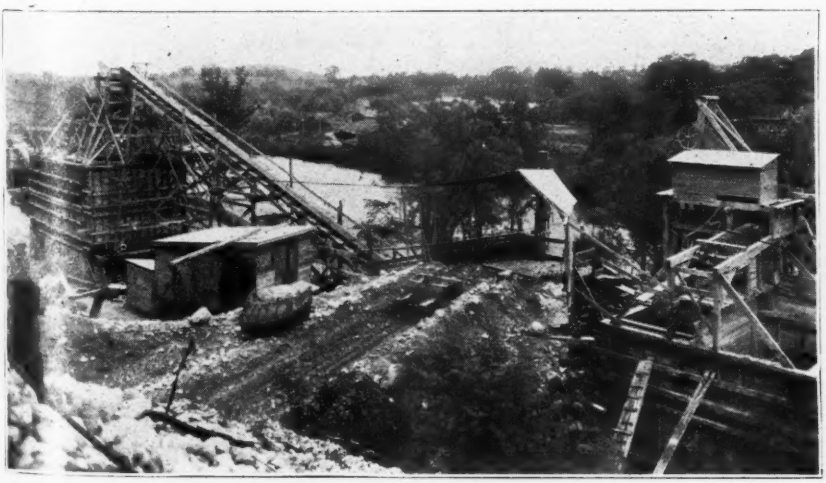
Balanced Plant of 1,000 Tons Capacity at Lennox Dale, Mass. Producing Stone, Gravel, Sand and Shope Concrete Brick

CONSTRUCTION was started on the new plant of the Berkshire Gravel Company in September, 1923, and completed in May, 1924. The plant is located at Lenox Dale, Massachusetts, on the east bank of the Housatonic River. The deposit covers 100 acres and runs about 75 per cent gravel and stone and 25 per cent sand. The sand is a very good grade and much of it is being absorbed by the company in the manufacture of Shope brick under the Shope patents. The plant at present has a capacity of 1,000 tons per nine-hour day.

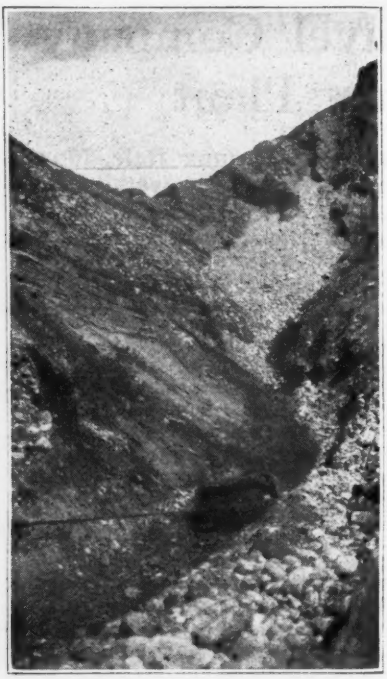
The material is dragged from the bank of a hill, which runs from 100 to 150 feet high, to the main hopper by a 2-yard Sauerman "Crescent" type bucket. When the digging is exceptionally hard a Sauerman 1-yard excavator type bucket is used. Railroad rails are placed on top of the hopper to keep out stone over 14 inches in diameter. The stone thus rejected is broken with stone hammers.

A reciprocating feeder moves the material uniformly from the hopper to a 12x4 foot cylindrical screen with 2½ inch perforations. Everything passing these perforations is taken to the screening plant. The large material goes to two New England crushers, one 14x28 inches and the other 11½x21 inches. The stone is taken from the crushers by bucket elevators of 50 foot centers to a cylindrical screen with ¼, ⅝, and 2½ inch openings. All oversize material from this screen goes back to the crushers. The crushed stone storage bins have a capacity of 400 tons and are equipped with single acting discharge gates. The bins are of concrete construction and have a double driveway underneath.

A 24-inch belt conveyor with 150 foot centers conveys the material to the screening and washing plant. A Worthington pump forces 500 gallons of water per minute into Dull conical screens. Stone of 2, 1 and ½ inch is graded at this end of the plant. The screened stone storage bins are also of concrete construction and they have a capacity of 1,500 tons. Duplex gates are used for all sizes except one where a Blaw-Knox batcher



A General View of the Plant.



The 2-yd. Scraper in Pit.

is used for the stone mixed for batch loading.

Two Link-Belt sand separators are used to handle the sand. One separator gives plastering and brick sand, and the other concrete sand. The separators are located on towers and the sand flows to the ground where the water runs off. The sand is then picked up by a ¼ yard Sauerman crescent type bucket and delivered to a hopper. This method does away with sloppy sand and permits large storage. A Blaw-Knox batcher is used as a discharge gate in the loading hopper. This permits batch loading of sand when necessary. Another Blaw-Knox batcher in the loading hopper feeds the mixer in the Shope brick plant.

Stock piles of various sizes and grades are conveniently located about the plant. This storage is in addition to the bin storage. Trucks are loaded from these stock piles by a Nelson one-man loader.

The entire plant is electrically operated. One 75 H. P. motor drives the Sauerman hoist for bringing in the material. One 75 H. P. motor operates the two crushers, automatic feeder and the scalping screen. One 20 H. P. motor operates the bucket elevator and the crushed stone screens. One 20 H. P. motor operates the belt conveyor and the conical screens. One 20 H. P. motor drives the Worthington pump. One 20 H. P. motor operates the ¼ yard Sauerman dragline handling the sand.

A Shope brick plant is operated in conjunction with the gravel plant. This plant is manufacturing brick under the protection of the Shope patented process controlled by the Shope Brick Company of Portland,

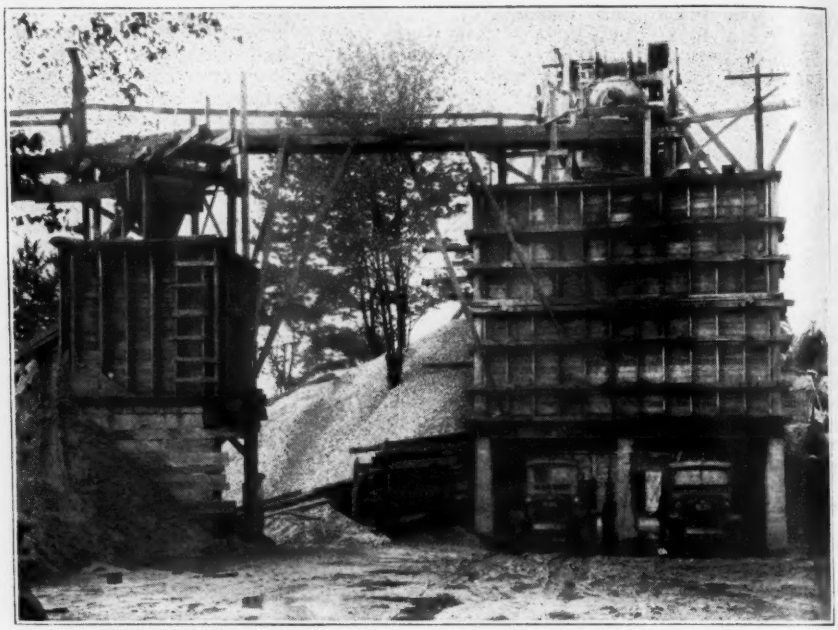
The ¼-yd. Scraper Reclaiming Sand from Pile to Loading Hopper.

Oregon. The brick plant consists of a work room 40x20 feet, four steam rooms 8x30 feet each, a cement and color storage room 15x30 feet and a boiler room. All the floors of the brick plant and also the outside storage yard are concrete.

A Blaw-Knox batcher drops the sand into a Blystone mixer. Concrete and sand are mixed thoroughly in this mixer. One man operates the mixer. He adds the cement and color and also controls the addition of water and the time of mix. The discharge from the mixer is taken by wheelbarrows to mix boxes alongside the brick machines. There are three brick machines in the plant. The moulds of these brick machines are filled by the operator from the mix box alongside his machine. In making the common brick the bricks are tamped, surplus material struck off, and the face of the brick sprinkled with water and neat cement. Each operator makes from three to five thousand common brick a day. In making face brick it is necessary to mix color with the cement. Coloring matter is also sifted onto the face of the brick. The brick is then flushed with water and the color pounded in with special brushes. Many designs of facing can be obtained. The number of face brick each operator can make in a day depends upon the finish or design of the facing. Many designs, such as moss, stipple, rough, etc., can be effected.

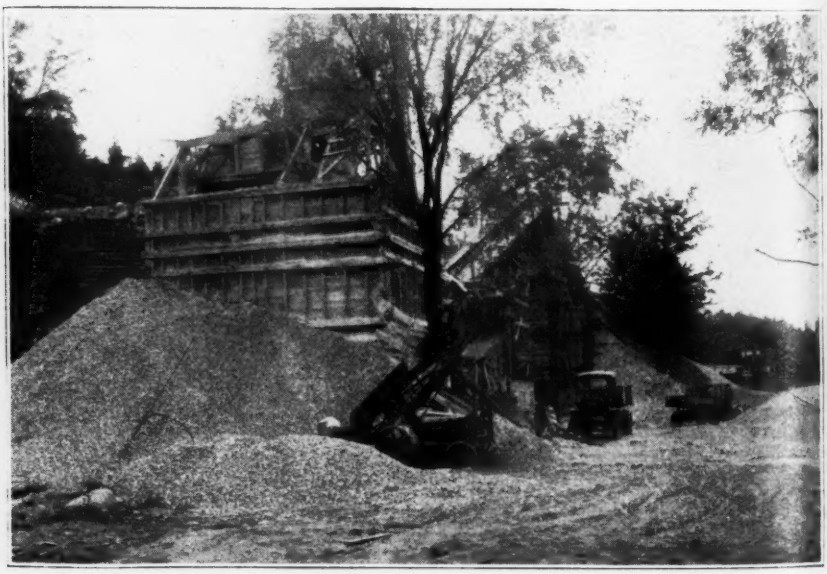
A pallet is inserted as a bottom plate before the bricks are made. This pallet is constructed so that one batch of bricks can be stored over the other. The pallet is a board with

The Conveyor to the Screening and Washing Plant.



The Loading Bins and Outside Storage.

a metal top. After the pallets and bricks are removed they are piled directly behind the operator. Two blocks a little larger than the bricks are placed upon either end of each row of bricks as they are piled. As the pallets with bricks upon them are piled up they are so spaced by the



Outside Storage Showing Loader In Foreground.

blocks mentioned that the top pallet does not rest on the bricks. This is in reality a self-spacing feature. As the bricks are manufactured, the pallets which hold ten bricks are taken out and piled nine or ten rows high, making a stack of 90 to 100 bricks.

A two-wheel rubber tired hand truck is used in conveying the stacks of bricks to the curing rooms. This truck goes under the bottom row of pallets and lifts the stack without any jar.

Each steam curing room holds about 7,000 brick. The bricks are steam cured for about 36 hours and then removed to the outside storage yard. A perforated pipe submerged in a trough of water is used in the curing rooms to effect an even distribution of steam. A double roof with an air chamber between was constructed to avoid excess sweating in the curing rooms.

A blacksmith shop handles the bulk of the repairs. A brick garage 25x100 feet has been built with a work shop 20x25 feet. A gasoline and oil house with tanks provides a storage of 2,000 gallons of gasoline and 250 gallons of lubricating oil.

All shipments are weighed on a 20-ton Bennington scale before leaving the plant. A modern office with three rooms has been constructed at the plant.

There are 24 men on the pay roll. Eleven men including a foreman and a blacksmith are employed in the gravel plant. Six men and a foreman are employed in the brick plant. Six truck drivers handle the trucking. All deliveries are made by truck. The company owns six White trucks. Additional trucks are rented as needed.

The Berkshire Gravel Company is owned by Mr. J. W. Washburn and Mr. A. I. Newton who, during their six years in the gravel business, have established an excellent reputation as producers of good clean sand and gravel and a reputation for quick delivery.

This plant is an excellent example of how a sand and gravel producer can develop a side line such as the manufacture of Shope brick to advantage.

The Cutler-Hammer Mfg. Co., Milwaukee, Wis., has issued a 48-page illustrated booklet, known as publication 3082, which describes Cutler-Hammer Electric Elevator Controllers.

Another View of Storage Facilities.

Fourth Annual Meeting of the Highway Research Board

The Highway Research Board will hold its fourth annual meeting on December 4 and 5, 1924, in the new building of the National Research Council located at B and Twenty-first Streets, Washington, D. C.

Mr. Thomas H. MacDonald, Chief of the Bureau of Public Roads, will present a paper on the "Financial Value of Highway Research as applied to Road Construction." Mr. MacDonald's keen sense of judgment on all matters pertaining to highways makes this paper an important one.

The various Committees of the Board will make their reports. Great interest has been aroused throughout the country as the problems that have been assigned to each Committee are common problems to all highway executives and engineers. These reports will include the Economic Theory of Highway Improvements; Structural Design of Roads; Character and Use of Road Material; Highway Traffic Analysis; Highway Finance; Highway Maintenance, and also a report of the Special Investigation on Reinforcement in Concrete Roads.

Research apparatus that has been successfully used in various experiments will be on display. This exhibit will not only include the apparatus used in laboratories, but will include also various loadometers, traffic counters and other instruments in use on the road.

On the evening of December 4th, Mr. Herbert Hoover, Secretary of the Department of Commerce, will speak at the Highway Research dinner.

This is the one meeting of the year where there is a rounded discussion of practical application of highway research. Highway executives and engineers will find this meeting to be one of intense interest because of the correlation of research and practise.

Rennolds Equipment Folder

Bulletin No. 104 is a new folder issued by the Rennolds Equipment Company of 343 S. Dearborn Street, Chicago, Ill. This company buys, sells, rents, trades and rebuilds equipment of all kinds. They also take equipment on consignment, rebuild and sell it, or else will store and rebuild equipment for the owner. The folder catalogs a long list of engineers' and road builders' equipment.

Shope Brick and Fire

A new folder issued by The Shope Brick Company of Portland, Oregon, is illustrated with engravings of the handsome buildings of the Pacific International Live Stock Exposition as they appeared on July 23, 1924. "Then," says the bulletin, "a fatal spark started the great conflagration which, when the smoke cleared away, left only a mass of ruins and fire-destroyed brick walls. It is scarcely conceivable that this huge $500,000 structure, covering ten acres was burned to the ground in one hour. Yet this is the fact. The fire raged a veritable blast furnace, sweeping all before it like chaff in a wind storm," because the buildings were built of ordinary brick walls.

The folder contains a number of illustrations of buildings built of Shope brick, and a letter from the General Manager of The Pacific International Live Stock Exposition Company calling attention to the fine showing made by Shope Brick in the fireplace in the Exposition Building which was built by the Shope Brick Company.

GMC Truck Booklet

General Motors Truck company has published for free distribution a pocket-size booklet containing seven articles on the "Care and Operation of Motors Trucks," by F. A. Whitten, chief engineer of the General Motors Truck company.

The new booklet is the articles which appeared in PIT AND QUARRY for October 1, 1924. It was published in the pocket edition in response to numerous inquiries from truck owners and operators who desired it for distribution to their employees.

The references and suggestions made are general and can be applied to all makes of trucks. Copies may be had if a request is directed to the local GMC distributor or to the General Motors Truck company, Pontiac, Mich.

Opinions on Thew Shovels

In a new folder the Thew Shovel Company of Loraine, Ohio, publishes the opinions of Thew users,—a series of letters in an art panel—and lists the names of the testimonial writers to whom those interested may write for opinions. One page is devoted to illustrations of the Thew Power Shovel in action on various jobs.

Cost Accounting in the Crushed Stone Industry

V.

Written expressly for PIT AND QUARRY by D. J. HUTCHINSON

The first of this series of articles appeared in the September number of PIT AND QUARRY. Some of the phases of the subject discussed in preceding numbers include accounting in its relation to selling prices, the application of uniform accounting methods, material as an element of cost, and expense analysis and distribution. This article will deal fully with general ledger control. Readers are invited to submit particular questions relating to cost methods to Mr. Hutchinson, care of PIT AND QUARRY.

—*Editor.*

WE HAVE seen in the previous articles how the cost of production is arrived at through analysing the total expenses incurred in the course of production and distributing these costs to the departments on account of which they were incurred. Each principal operation, as blasting, drilling, etc., was taken as a department, and by determining the expenses chargeable to each the departmental cost of each such principal operation was determined.

Before leaving this subject of distribution, we wish to point out that the same principles can be employed to determine much more detailed costs than we have attempted in these pages. Thus, for example, operating labor, Account 01, in the quarry can be further subdivided as follows:

1301	Operating Labor (Quarry)
130101	Track Labor
130102	Pit men
etc.	

Or blasting can be divided between primary and secondary blasting. In the mill, primary crushing, secondary crushing, and screening can be taken as separate operations, and the costs of each can be determined by a more refined analysis of the expenses. All this is largely a matter of how far one wishes to go and how much one is willing to spend to get the results, or, rather, how far the results justify the expenditure. These questions, both as to the exact methods of procedure and as to matters of policy, must be determined largely by the conditions in each plant and its competitive position. They can only be indicated here, leaving each operator to go as far as he wishes, which he can do without altering the general principles of cost finding that we have outlined.

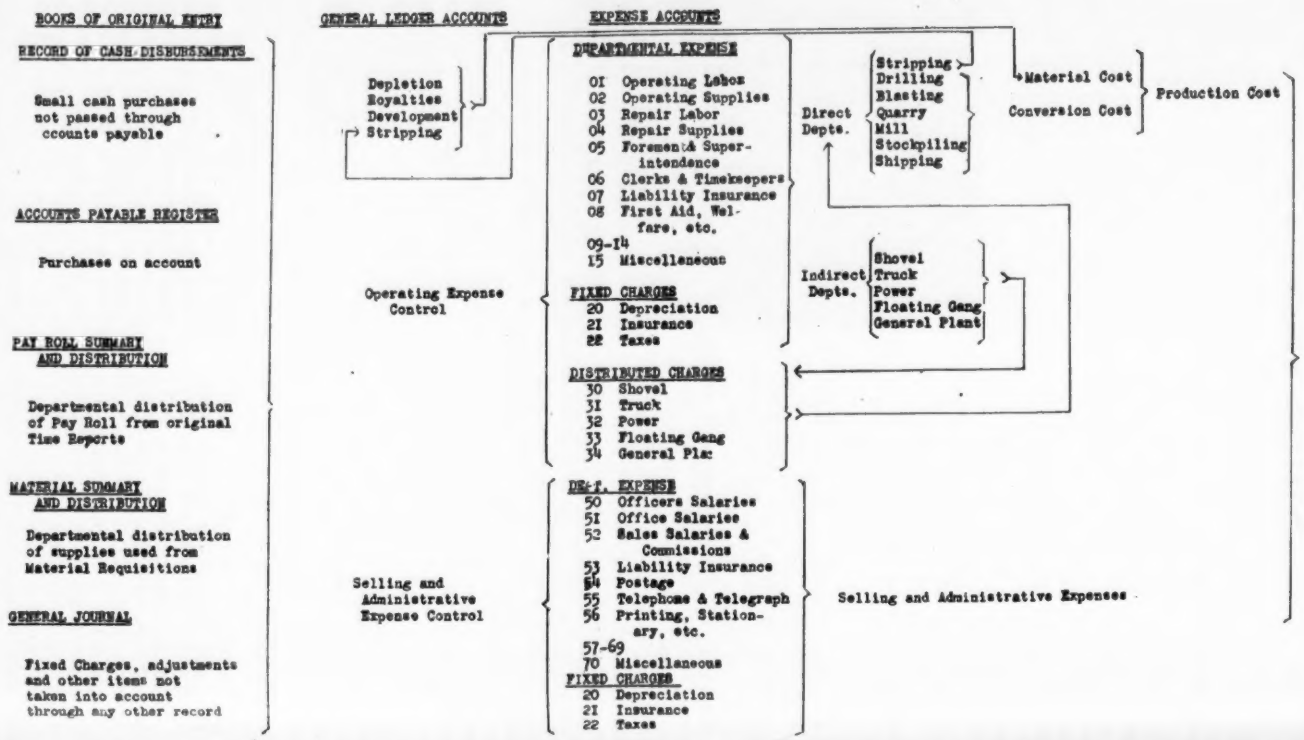
D. J. Hutchinson.

Relation of Cost Accounting to General Accounting

Having seen that the cost of production is derived from the various items of expenses entering into production, it is now necessary to examine the sources of these expense items and the methods of recording them that enable the proper analysis to be made. These questions involve the relation between the cost and general accounting procedure.

Fortunately, the idea of cost accounting as something distinct and essentially different from general accounting is not now so generally accepted as it once was, but there are still a great many so-called memorandum cost systems in operation that are the product of this idea. Cost accounting as we have been considering it, however, is a phase merely of general accounting, and the expense ac-

CHART OF ACCOUNTING PROCEDURE



counts with which we have been dealing comprise an integral part of the general financial records.

Of course, an accounting procedure which kept these records in the General Ledger would be impossibly cumbersome, but they are, nevertheless, as much a part of the General Ledger as the customers' accounts are, although in each case the detail is kept in separate records. The detail customers accounts, for example, are represented in the General Ledger by the Accounts Receivable (control) account, with which they agree in total. The cost accounts are similarly "tied in" to the General Ledger by the Operating Expense Control.

It is only by thus "tying" the cost records into the General Ledger that we can secure any check on their accuracy, and without such a check it is difficult to place any reliance on them. It has been the writer's observation that the greatest weakness of many cost accounting systems is the failure of the responsible executives to make use of the data presented, due to a lack of confidence in the figures that is often only too well justified.

Therefore, while the General Ledger and the books of original entry are more properly the subject of general accounting than of cost accounting study, some notice of them is necessary to our subject, which is in a sense only one aspect of general accounting. The following is a somewhat condensed General Ledger Chart of Accounts, which is not intended to be complete, but merely to illustrate the relation between the cost accounting procedure and the General Ledger.

ASSETS

Current:
- Cash
- Notes and Accounts Receivable
- Inventories:
  - Supplies
  - Finished Product

Other Assets:
- Investments

Permanent:
- Quarry Site (or value of Leasehold)
- Reserve for Depletion
- Depreciable Assets (Classified departmentally and preferably supported by a Plant Ledger (See Articles III and IV.)
- Reserve for Depreciation

Deferred Charges to Profit and Loss:
- Deferred Development Cost
- Deferred Stripping Expense
- Deferred General Expenses (Taxes, Insurance, etc.)
- Unamortized Bond Debt Discount and Expense

LIABILITIES

Current:
- Notes and Accounts Payable
- Accrued Liabilities (Salaries, etc.)

Funded Debt:
- Bonds (or Mortgages) Payable

Capital:
- Capital Stock
- Surplus
- Profit and Loss

REVENUE

Income:
- Sales
- Cost of Sales

Expense:
- Operating Expense Control
- Selling and Administrative Expense Control
- Depletion
- Royalties
- Stripping Expense (charged off)
- Development Expense (charged off)

Other Income:
- Interest, Dividends, Rents, etc., (Earned on Investments) Interest on Bank Balances, Notes and Accounts Receivable, Cash Discounts taken on Purchase (unless deducted from cost)

Other Deductions:
- Interest and Discount on Notes and Accounts Payable, Bond or Mortgage Interest, Amortized Bond Debt Discount and Expense

From this chart it will be seen that with the exception of the royalty and depletion items, etc., the operating expense (cost) accounts that we have heretofore been considering are represented in the General Ledger by one account, the "Operating Expense Control."

The books of original entry, as the name implies, are the records in which the various transactions of the business are first taken into the accounts, and the arrangement of these books so that the expense figures can be readily analyzed from their pages is an important part of the cost accounting procedure. The books of original entry usually consist of the following:

- Cash Receipts Record
- Cash Disbursements Record
- Accounts Payable Record and Purchase Distribution
- Pay Roll Summary and Distribution

A B C STONE COMPANY

CASH DISBURSEMENTS RECORD

MONTH OF 192

DATE	PAID TO	IN SETTLEMENT OF	CHECK NO	CREDITS			DEBITS								
				CASH	DISCT.		RECTS. PAY	SUPPLY INVENTORY	OPER. EXP. CONT. ACCT.	✓	AMOUNT	S. & A. EXP. CONT. ACCT.	✓	AMOUNT	GENERAL LEDGER ACCOUNT	✓	AMOUNT

PAGE

A B C STONE COMPANY

ACCOUNTS PAYABLE RECORD AND DISTRIBUTION

MONTH OF 192

DATE	BOUGHT FROM	PAID BY CHECK NO	CREDIT	DEBITS									
			ACCOUNTS PAY.	SUPPLY INVENTORY	OPER. EXP. CONT. ACCT.	✓	AMOUNT	S. & A. EXP. CONT. ACCT.	✓	AMOUNT	GENERAL LEDGER ACCOUNT	✓	AMOUNT

A. B. C. STONE COMPANY

COMPARATIVE COST STATEMENT

Month	Prod.	Stripping Per Yd.	Drilling Per Yd.	Blasting Per Yd.	Quarry Per Yd.	Mill Per Yd.	Stockpiling Per Yd.	Load. &. Ship. Per Yd.	Total Per Yd.
January Last Year	Enter Last Year's Figures in Red.								
February To Date									
Last Year To Date									
March To Date									
Last Year To Date									
etc.									
etc.									
etc.									
etc.									
December To Date									
Last Year To Date									

Material Summary and Distribution

Sales Summary and Distribution

General Journal

The Pay Roll Summary and Distribution was illustrated in the previous article, and the Material Summary follows the same general form. The Sales Summary and Distribution and the Cash Receipts Record ordinarily do not directly affect the cost accounts, although there may occasionally be entries, particularly on the latter record, that result in credits to the expense accounts. These, however, are unusual and are so few that they can be handled without confusion through the "General Ledger" columns. The entries coming through the General Journal are also relatively few, and for the most part are the fixed charges or adjustments. These also can be posted individually, and the ordinary two-column Journal will be adequate in most cases.

From the standpoint of the cost accounting records, therefore, the important forms are the Cash Disbursements Record and the Accounts Payable Record and Purchase Distribution. It will be noted that each form provides a column for the charges to the Operating Expense Control and to the Selling and Administrative Expense Control, showing both account number and amount. A blueprinted or typewritten copy of the Chart of Expense Accounts should be placed in the hands of the person responsible for passing invoices for payment so that the distribution of the charges, giving the expense account numbers to which the charges are to be made, can be noted on the face of the invoice or voucher attached if the voucher system is in use. The account number is then entered opposite the amount in the appropriate column when the invoice is entered. Cash purchases not passing through the accounts payable are handled in the same way in the Cash Disbursements Record by indicating the account number to which the item is to be charged in the debit column.

When the entries for the month are complete, the records are totaled and cross-footed (each form, it will be noted, is self-balancing) and the totals posted to the General Ledger accounts.

The detail expense charges are then summarized on ordinary columnar paper by assigning a column to each expense account and entering the amounts charged in the appropriate columns. The totals of the columns are carried to the Analysis of Expense accounts. This method of analysis is quicker than posting to expense accounts, and the information is presented on the expense analysis in the form in which it is desired without the additional operation of making up reports from the accounts.

In making up the summary, the charges from all sources, Accounts Payable Record, Cash Disbursements Record, General Journal, Pay Roll Summary, etc., must of course be included. Some accountants prefer to pass the totals from the Pay Roll and Material Summaries through the Accounts Payable Record. There is no objection to this procedure, except that it seems to involve another operation that is unnecessary, since the totals can be posted and the detail analyzed directly from the original records. The correctness of the expense summary is determined by the fact that the total carried to the Expense Analysis sheet must agree with the total charge to the Expense Control for the month.

The Analysis of Expense Accounts is a monthly report on operation, the totals of which are carried to the Comparative Cost Statement which gives the accumulated totals for the year, compared with the previous year's figures. The last total on the

Comparative Cost Statement must agree with the total to date in the Expense Control without the stripping charge, which, as we have noted, is adjusted by crediting the Expense Control with the monthly cost and charging back the stripping cost per yard produced.

The Chart of Accounting Procedure illustrates the course of the cost figures from the books of original entry to the final cost figures.

The total in the Operating Expense Control and the depletion and stripping expenses are transferred by journal entry to the finished product inventory account, which is in turn credited and the cost of sales charged with the inventory cost of stone shipped. Ordinarily royalties are paid on the basis of the material actually shipped rather than on the amount produced, hence this charge will not be included in the inventory, but will be made directly to the cost of sales account.

One important advantage of proper cost records is that these figures may be obtained every month, so that the progress of operations may be known as they proceed without waiting for the formal closing of the books at the end of the year. This does not mean that the accounting department will go through the routine of actually closing the books every month, as too much unnecessary labor would be involved. The information relative to sales and costs can be taken from the books, however, and monthly operating statements prepared in the following form:

SALES			$xx xxx xx
COST OF SALES:			
Inventory First of Month	yds.@	$ x xxx xx	
Monthly Production	yds.@	x xxx xx	
Average	yds.@	$ x xxx xx	
Inventory End of Month	yds.@	x xxx xx	$xx xxx xx
GROSS OPERATING PROFIT			$ x xxx xx
SELLING AND ADMINISTRATIVE EXPENSE			x xxx xx
NET OPERATING PROFIT			$ x xxx xx
OTHER INCOME AND DEDUCTIONS			xxx xx
NET PROFIT			$ x xxx xx

Thus far we have discussed only the Operating Expense Accounts. These are the accounts with which we are primarily concerned in determining the cost of production. However, the total cost of the product must include the selling and administrative expenses as well. These are charged in totals in the General Ledger from the books of original entry to the Selling and Administrative Expense Control, and analyzed in detail in the same manner as the operating expenses. In most cases, however, we have to deal here with only one department, instead of several. In most quarries, particularly the smaller ones, it is impossible to distinguish between the sales and general administrative activities, both of which are carried on to a large extent by the same individuals. However, the principles of departmentalization used in the operating departments can be applied in the office end of the business as well, and the sales and administrative departments separated if desired and if it is practicable to do so.

One reason this has not been attempted in these articles is that a great many crushed stone plants are operated as departments of more extended enterprises, including oftentimes such activities as paving contracting, cement manufacture, sand and gravel production, etc. The sales and administrative forces, therefore, would be concerned with activities beyond our present scope.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued Publication 1579-C containing 16 pages, illustrating and describing Westinghouse Micarta Gears and Pinions.

Combustion Engineering Corp., Broad St., New York, has issued Catalog E-5, containing 23 illustrated pages descriptive of Type E Stoker.

Draft for Boilers

Written Expressly for PIT AND QUARRY by DANIEL J. HAUER.

The most important factor in operating a boiler is the draft furnished to the fire bed. Without draft there could be no combustion. With too little draft there are large losses in burning the fuel and with too much draft the losses can be equally as large. It is necessary to have the proper amount of draft supplied to the fire bed to reach any degree of efficiency.

Draft for combustion is furnished in three essential ways. One way is through the ash pan. Another is through the fire door. The third way is by the pull of the stack. There is a fourth way through the fire walls. Generally speaking any air furnished through the fire walls is due to cracks and holes that should not be there. With such openings in the fire walls there is no way of regulating the draft thus obtained and it operates against the fire.

A stack to a boiler must be large enough both in diameter and height to allow sufficient volume of air and gases to pass through to keep the fire under the boiler burning with the greatest amount of carbon dioxide combustion. It might be well to remark that there are two kinds of combustion that take place in the fire box of the boiler. Coal is mostly carbon and when a fire is once started oxygen must be supplied to it to make it burn. If equal parts of oxygen and carbon occur in the fire box this is called carbon monoxid. The fire burns slowly with a blue flame and the tar that is generally found in the coal is melted so that it runs and fills up the air spaces in the fire bed. The supply of oxygen is soon cut off and the fire becomes black and the volume of black smoke rapidly increases. With such a fire the coal is slowly coked and the heat units in the coal are not liberated rapidly enough for use. The result being that the pull of the air through the stack carries large volumes of unconsumed gases up through the stack with a heavily carbon ladened smoke. When this condition exists the stack temperatures become nearly as high as those of the combustion chamber and very little steam can be produced from the water, although a large amount of coal can be burned.

When two parts of oxygen are furnished to one of carbon, we have carbon dioxide combustion. The fire burns brightly and the gases in the upper and back combustion chamber keep burning. This combustion continues through or around the tubes of the boiler so that by the time they reach the stack all but a small per cent of the gases are consumed and only a small volume of light gray smoke passes through the stack. With this combustion nearly all the heat units in a pound of coal are liberated either under the boiler or as the gases pass through the boiler and are made available for evaporating the water into steam. When carbon monoxid combustion occurs with bituminous coal the only way to overcome the difficulty is to furnish more air through the grate and this is generally done by running a slice bar under the fire bed raising it up and breaking the fire bed so that the proper amount of air can pass through to give carbon dioxide combustion. A fire bed under a boiler can have at the same time both carbon monoxid and carbon dioxide combustion. Large volumes of dense smoke coming from the stack means incomplete combustion with low carbon dioxide and high carbon monoxide. It is possible to get a fair idea by looking at a fire and watching to learn if there is sufficient draft or air being furnished and if mostly carbon dioxide combustion is being obtained. The only accurate way to tell about either condition is to use a draft gauge on each boiler and a carbon dioxide meter to record the combustion.

Generally sufficient air can be furnished through the ash pan and grate, if the fire is handled properly, to give carbon dioxide combustion on the grate. This does not mean however, that when the gases are liberated from the coal and enter the upper combustion and back combustion chambers that sufficient air is furnished through the grate for the proper combustion of the gases before they reach the stack. To furnish this additional air there is either a clock arrangement or a slide in the fire doors to admit air over the fire bed for the further combustion of the gases. Many operators are un-

der the impression that the air admitted through the fire doors is to cool off the fire. This is not the case. This additional air is needed for combustion and the temperature is increased rather than lowered. Opening the fire doors results in too much air. The temperature is lowered considerably and the gases are swept into the stack without being consumed.

There are several patented systems of feeding air into the upper combustion chambers by means of ducts in the fire walls. These either come from the ash pit or by means of pipes from the outside of the boiler setting but they are always arranged so that the amount of air supplied can be controlled. These systems of introducing air into the upper combustion chamber have not been used very extensively.

The amount of air needed in the fire bed and combustion chambers varies at different times depending upon the method of firing. When green coal is first thrown onto the fire, more draft and air is needed than when this coal becomes heated and is burning at a fairly good rate. If firing periods are every fifteen minutes apart the maximum amount of air is needed for good combustion during the first three or five minutes. During the next five minutes considerably less air will be needed while during the last five minutes only the minimum amount of air is necessary. This flow of air can be checked and increased by means of the ash pan doors but this is generally an expensive procedure. If the boiler is equipped with a draft gauge it will readily be seen that the vacuum on the gauge will be considerably increased upon closing the ash pan doors. The flue gas temperature is reduced and naturally steam production is lowered. With the ash pan doors closed the inflow of air through all the cracks and holes in the fire walls is increased. This means poor combustion and a waste of coal.

Although the ash pan doors can be used to regulate the draft it is not the correct method to follow except in a few unusual cases. The regulation should be through a damper. Every boiler and stack should be equipped with a damper that can be easily regulated. A boiler operated by levers is better than no damper. The types recommended are those that are automatically controlled. It is a general practice in designing and setting boilers to attempt to provide an excess of draft or air. To reduce this excess dampers are then used. If the operator leaves the dampers entirely open or even a little too much there is not the control that there should be and coal is wasted. It is important to have not only the proper design but also the proper regulation of the draft system.

It is surprising in inspecting boilers to find how many have poorly designed combustion chambers. The upper combustion chamber is frequently too small. The bridge wall may be too high or too low. A high bridge wall throws the gases against the front of the boiler which quickly ruins it. Too low a bridge wall will sweep the gases over it before real combustion of the gases takes place. If the upper combustion chamber is too small the gases are not held in but are swept at once into the back combustion chamber. Both for return tubular boilers and water tube boilers there should be baffles in the back combustion chambers to hold and keep back the gases as combustion is taking place. Without the correctly designed chambers and with poor placing of the baffiles the gases are quickly swept into the stack and the heat units lost.

The correct amount of air must be furnished and it must likewise be controlled through the various stages of combustion. Today we have four systems of draft. The one in most common use is natural draft. In this system the draft is furnished in the ordinary way through the ash pan, fire doors and the stack. As already pointed out the control of this draft system is in the design of the combustion chambers and the boilers and the control must come principally through the damper.

The second system of draft is known as forced draft. Here a fan operated either by an engine or a motor, drives air into the ash pan or pit. This introduces more air into the fire bed than can be obtained from natural sources. This air not only goes through the fire bed but through the various combustion chambers and also out into the stack. By means of natural draft and the proper design of boiler setting with ample stack, boilers can be given an overrating and this rating can be maintained through an operating day. For example, a 200 H.P. boiler with forced

draft can be pushed to produce steam enough to give the boiler a rating up to 400 H.P. If this is desired, many deficiencies that may occur with natural draft can be overcome. With forced draft damper control is also of importance.

The third system is to use induced draft. Here the fan is placed in the breeching of the boiler and as the other fans is either operated by a steam engine or a motor. The gases and smoke pass through the fan. For this reason the bearing of the fan must be water cooled. The object of induced draft is to pull the air through the fire bed and the combustion chambers and drive it with considerable force through the breeching and up through the stack. It does not answer the purpose of the forced draft as the same amount of air is not forced through the fire bed unless the fan and engine are much greater than those used for forced draft. Induced draft does overcome many stack troubles and if a stack is too small it is possible within certain limits to make it handle the boilers efficiently by installing an induced draft system. In some cases it is necessary to overcome draft troubles to use both forced and induced draft.

The fourth system of draft control is known as the automatic control method. For hand fired boilers this is a system of controlling the damper. All of this control is automatic. With mechanical stocker and automatic control rate of feeding the fuel is regulative and every other factor is properly controlled if the whole setting is correctly designed. There have been a number of types of equipment designed for obtaining automatic control of the draft system and most of these have to a great extent been successful. There are certain limitations in the installation of these systems. It would not be good business policy to install a draft system where only a small amount of coal is used in a year. There must be enough coal used to balance the saving these systems can effect with the cost of their installation and operation.

In considering automatic control it should not be confused with the automatic control of dampers and the forced and induced draft systems. A damper may be controlled by a lever but many operators even if these levers are put within their easy reach, do not attend to the damper. Hence, more satisfactory results are obtained by an automatic damper regulator that is connected up with the boiler. It is the same case with forced and induced draft. Different amounts of air are needed during the different stages of combustion and the tendency of the operator is to start this engine or motor and let it continue running all the time. In many cases too much draft is being furnished to the fire and the best results are not obtained. To overcome this difficulty an automatic control of the engines can be used so that the fan furnishes the maximum air needed when necessary and may entirely cut off the supply when not needed. These two are termed automatic control of the forced draft systems.

These various systems can be used for bituminous coal and for the thousands of small plants in the country natural draft is the prevailing method. If anthracite coal is used, especially the smaller sizes down to screenings, artificial draft is generally used even for small boilers. It is not possible to get sufficient air through the closely set grate used in burning such small grain coal. With forced draft the amount of air that is allowed to go through the grate is reduced while the speed of feeding the air is increased. This condition has brought on the market many systems or designs of grate for burning this class of coal. The tendency of all these small grain anthracite coals is to badly clinker and if a fire is not frequently cleaned the fire bed becomes deep with clinkers and ashes. The air must first be forced through this bed of dead material before it reaches the burning coal, and unlike a fire using bituminous coal, the fire bed cannot be disturbed by a slice bar to give it more air. The grate must be cleaned in sections and new fire spread over those parts that are clean.

It is evident from the facts presented that the grate under a boiler plays a most important part in combustion. All grates, when a fresh fire is started and the fire bed is not very deep, will supply sufficient air for carbondioxide combustion, but as the grate becomes foul with dead ashes and clinkers the supply of air is cut off and much carbon monoxide results. A grate should have sufficient openings to supply enough air after the fire has been cleaned to last until the next cleaning period. There should be frequent cleaning periods or the grate must be of such design

and have such mechanism that it will clean itself without the use of fire tools or the opening of the fire doors. A grate that has as clean a fire at the end of the day's run, as it had at the beginning of the day, is certainly superior and the type to be used.

Such a grate with the proper damper control or regulation with natural draft should give ideal combustion. It is not possible to get the best regulation of the damper from the steam pressure. The regulation should come from the draft over the fire bed and each boiler should have its own damper regulation. These two factors also play an important part with artificial draft system and the grates should be set to prevent too much air passing through at one time. This is particularly true of hand fired boilers. With mechanically fired boilers a different type of grate should be used.

What has been said would be misleading if a word were not said about the load on the boiler. If the load is steady and regular throughout the operating day, what has been said applies. With a fluctuating load the amount of steam needed will vary, and therefore, the regulation of the fire must vary with the load. In this case the dampers should be adjusted to the load and the amount of air coming through the grate should always be regulated by the load and the firing of the coal should likewise vary with it. The value of a good grate with a fluctuating load is important. If the steam pressure is low and must be quickly increased this is accomplished by accelerating the combustion and this means more draft through the grate. A grate with ample air passing through and with a cleaning mechanism that will clean quickly will improve the rate of combustion so that on short notice the steam pressure can be quickly increased to carry additional loads. Naturally the load is the important factor in operating the boiler and should be the governing factor.

Every operator who owns a boiler should attempt to increase the efficiency of the boiler with a decreased coal consumption. It is surprising how easy it is to save 5 to 10 per cent of the coal consumed by the correct use of the many devices. It is a fact that although manufacturers of various boiler appliances make big claims for saving coal, yet in many cases their claims can be exceeded.

Small Automatic Stoker

A new stoker has recently been brought out which burns cheap fuels efficiently, thereby decreasing fuel costs. A decreased amount of coal is consumed, the amount of ash and unburned fuel is reduced, smoke is eliminated, and its automatic operation provides convenience, safety and economy.

This Stoker is designed to introduce coal—screenings or any coal below the grade of No. 2—into a boiler of 250 H.P. or smaller. It burns it smokelessly, cares for the ash element by discharging it into a hopper, all automatically. There are only three moving parts throughout the entire mechanism so that it is operated by a ¼-H.P. motor or hydraulic drive of equal power.

The base of the coal hopper is a reciprocating place, carried on roller bearings, which has a length of travel up to 5 in. and can be adjusted to feed the proper amount of coal. The stoker is a self-contained unit, adaptable to all heating and steam-making boilers with little alteration. The grates are terraced. The first and third grates have a forward and backward sliding motion over the second and fourth, which are stationary. The result is that the coal travels forward and coking coal can be burned efficiently.

Directly under the ash opening at the rear is the ash plate. This also has a reciprocating motion which moves the ash toward the front although the ash opening is at all filled with ash to prevent entrance of cold air. Practically all of the ash heat is retained by this method and complete combustion is made possible.

Both natural and forced draft can be used. The results of an 8-hour test of a stoker installed in a 150 H.P. boiler of the H. R. T. type burning Illinois screenings under forced draft were: No smoke; 13 per cent CO_2 average; 237 H.P. average; 911 lb. water evaporated per lb. of coal fired; 12.06 per cent combustible in ash; fuel cost of evaporating 1,000 lb. water 26 cents.

Further information on this stoker may be had by addressing the editorial department of PIT AND QUARRY.

Whiting Corp., Harvey, Ill., has issued two illustrated folders. One describes Hydraulic Regulating Gates and the other is descriptive of the Type C Electric Solenoid Brake, especially designed for crane service.

Great Activity in Texas

Roadbuilding Is the Favorite Occupation of Towns and Counties in Lone Star Country. Dallas Shows Unusual Growth

By Our Dallas, Tex., Correspondent

SAND and gravel dealers of Dallas continue to do a heavy business, particularly those who specialize in sale of such building materials delivered on the job. Building operations continue on a large scale, street paving and road improvement projects are in full swing, and the demand for sand and gravel continue to increase.

Dallas has shown an unusual growth during the last year, and the outlook for even more building next year is bright. Several large building projects are to be realized soon, from which the demand for sand and gravel will be unusually heavy. The city has recently awarded contracts calling for street paving to cost possibly $6,000,000. Under the street paving program adopted in Dallas, the property owners pay for the paving, with the exception of the street intersections, these being paved by the city. At the election last year street improvement bonds to the amount of $1,750,000 were voted. These bonds have been sold and this amount is now available in the city's street improvement fund for paving street intersections in the city's general street improvement program. With this amount the streets ordered paved will mean the laying of more than twenty-five miles of concrete street paving in the city during the next eighteen months.

Due to the unusual demand for gravel and sand in the city delivered on the job, several gravel companies have purchased and are now operating large fleets of motor trucks, hauling gravel from the pits along the Trinity River bottoms to the city. Gravel is being delivered on the job at $2.00 to $2.25.

The Smith Gravel Company remains to be perhaps the largest shipper of gravel from the Dallas territory. This company has not put in operation a fleet of motor trucks, but delivers some gravel on the job, contracting with other firms for the haulage from railway car to the job. This company puts gravel in the switching area of the city of Dallas for $1.65 per cubic yard, allowing the purchaser to do his own hauling from the car to the job. This same company is putting sand inside the city's industrial district for $1.25 a ton, f. o. b. cars.

Prices for sand delivered on the job range from $1.75 to $2.25 per ton. Dealers in Dallas estimate a cubic yard of sand at 2500 to 2600 pounds. Most of the sales, however, are made by the ton.

Building operations in other Texas cities and towns continues unabated, reports received in Dallas indicate, and the gravel and sand business continues good all over the state. Numerous highway construction contracts are now being awarded, and large quantities of gravel are being used in road building. In many parts of Texas good road building materials are not available, and must be shipped in. Gravel dealers in Dallas have shipped and are now shipping much of this road building material.

The city of Jacksonville, Texas, has voted $100,000 in bonds for street paving, and will soon award contracts for concrete pavement in its business district.

The city of Ennis is now engaged in laying street pavement, which will cost more than $200,000 when finished. Of the paving the city will pay $50,600 of the cost, property owners $135,000. Texas Electric Railway $15,600. Agitation is already started for an additional bond issue of $200,000 for additional paving.

The city of Temple, Texas, has awarded contract to K. S. Hull, Jr., of Temple, for 25,000 square yards of brick and concrete street paving. Contract will also be awarded soon for an additional 20,000 square yards.

The Brownwood Rock Crusher Company, which recently installed a mammoth rock crushing plant near Brownwood, is now shipping an average of twenty-five carloads of crushed rock a day. The rock is being used in road building operations.

A. T. Manning of Fort Worth, Texas, old-time rock quarry owner and operator of Texas, died at his home in Fort Worth recently at the age of 61 years. Mr. Manning quarried the rock from which the Tarrant County courthouse was built. This rock was taken from Manning's Quarry, a noted place, just west of Fort Worth and between Fort Worth and Weatherford. After operating this rock quarry for many years Mr. Manning moved to Mexico and built up an extensive rock quarry and con-

struction business. He was forced to give up this business during the revolution in Mexico and returned to Fort Worth, where he made his home until his death.

Cameron, Texas, has awarded contracts for paving the business streets of the town.

Bond issue of $150,000 has been approved by the voters of Tyler, Texas, and the proceeds will be used in paving additional streets.

The road precinct of Electra, in Wichita County, Texas, has voted $500,000 in bonds for building additional highways. A concrete pike from Electra to the new Lake Kemp on the Wichita River south of Electra will be built. The bond issue has been sold, and contracts for construction of the highway are to be awarded soon.

The Womack Construction Company of Sherman, Texas, has been awarded contract for grading and graveling four miles of highway in the Red River Bottoms between Texarkana and Garland City for $23,500.

W. B. Marsh, chairman of the Smith County Highway Association, whose home is at Tyler, Texas, announces that an additional ten miles of concrete highway will be built in Smith County, contract for which will be awarded soon.

Fannin County Commissioners, sitting at Benham, have voted to set aside $10,000 which will be the county's portion of the $30,000 needed to close the one-mile gap in the Windom-Dodd City highway, crossing the county from east to west. The road will be built of concrete and the state will pay one-third, the federal government one-third and Fannin County one-third.

County Commissioners of Wilbarger County, sitting at Vernon, awarded contract to J. P. Foty for ten miles of crushed rock and gravel road in the eastern part of the county. The improvement will cost about $20,000. Bids are to be asked soon on the construction of a concrete highway connecting with the concrete highway in Wichita County and with the concrete pike in Wilbarger County on the Colorado-to-the-Gulf highway. A bond issue of $150,000 has been voted and this sum is available for building this stretch of highway, which will be 16-feet in width and complete the highway across Wilbarger County.

The city of Cloburne, Texas, has awarded contracts to the West Construction Company for street paving to cost $169,125.42. The pavement is to be of concrete.

Nolan County, of which Sweetwater is the county seat, will soon ask bids for the construction of 15.2 miles of concrete highway on the Bankhead Highway in this county. This stretch of road building will be a part of the highway costruction program this county entered upon with the voting of $1,500,000 in bonds.

The County Commissioners of Hill County, sitting at Hillsboro, Texas, have awarded contracts for $416,654.30 to Julian S. Field of Denton, Texas, covering the building of a concrete roadway on the Colorado-to-the-Gulf Highway from Hillsboro to the Johnson County line.

Blaw-Knox Announces Arthur Levison

The appointment of Arthur Levison, Highway Engineer, United States Bureau of Public Roads, as Chief Engineer of the Road Building Department is announced by the Blaw-Knox Company of Pittsburgh.

Since his graduation from New York University in 1910. Mr. Levison has been actively connected with construction work. For one year he was Inspector of Road Construction of the New York State Highway Department. During the four years following, he officiated as Assistant Engineer of Barge Canal Construction, New York State. At the end of this period, he became Assistant Engineer in Subway Construction in New York City.

Mr. Levison was then appointed Engineer in charge of reinforced concrete building construction at the Washington Navy Yards, which position he held four years. He next became connected with the United States Bureau of Public Roads as Highway Engineer, co-operating with Highway Departments in the middle west. After the successful termination of this work, he again returned to Washington and was placed in charge of devising and conducting research on concrete pavement construction.

Mr. Levison's wide experience commended itself to government officials and will be utilized by the Blaw-Knox Company in both improving the design of their road building equipment and to develop new apparatus.

The "Apex" CO_2 Recorder

Realizing that most of the smaller plants and even some of the larger plants consider the prevailing cost of CO_2 recorders too high to warrant investing in them, the Uehling Instrument Company of Paterson, N. J., has just started to introduce an entirely new inexpensive CO_2 recorder known as the "Apex". Inasmuch as the price of the new recorder is very small, it is believed that the new instrument will open up an entirely new field among the smaller plants. In fact it is stated that the anticipated fuel savings will warrant its adoption for boilers of 50 horse power or over. The "Apex" CO_2 recorder employs no chemical solutions and there are no moving parts excepting the pen mechanism. The "Pyro-Porus" filter and the standard Uehling gas dryer and desulphurizer are used, insuring absolute cleanliness of the gas line and interior parts of the instrument permanently. As a result of these features the manufacturer claims that the recorder will operate accurately without any attention or adjustment other than the changing of charts and renewals of dry absorbent which should not exceed 10 minutes weekly. This instrument will be exhibited for the first time, in both recording and indicating types, at the Power Show which will be held at the Grand Central Palace in New York during the first week in December.

Pioneer Excavating Outfits

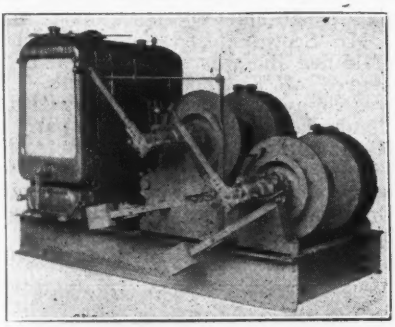
A new folder issued by The Mansfield Engineering Company 1013 Fletcher Savings and Trust Building, Indianapolis, Indiana, describes the Pioneer Back-Dump Slack Line Bucket. One illustration shows three PIONEER Outfits on one contract.

Because competition is strong in this modern age, success requires up-to-date equipment. The PIONEER, it is said, has kept ahead of the times. Simple to erect and operate. Slack line excavation is a special branch of engineering that has been developed during the past ten or fifteen years, resulting from the need of a cheap method of excavating material over a large area and storing same in bins ready to be loaded by gravity into cars or trucks.

PIONEER buckets are built in different sizes to suit customers' requirements. Illustrations show this equipin operation on a variety of jobs.

New Domestic Hoist

A new piece of equipment recently put out by the Domestic Engine and Pump Co. of Shippensburg, Pa., is their new Heavy Duty Hoist. This hoist is equipped with a four cylinder 30 H. P. gasoline engine, as shown in the accompanying illustration. Additional information may be had from the manufacturers upon request.



The New Domestic Hoist.

New Economy Pump Bulletins

Two new pump bulletins recently issued by the Economy Pumping Machinery Co., of 122-124 North Curtis Street, Chicago, Ill., are *Bulletin No. 404*, dealing with Economy Centrifugal Double Suction Pumps, and a four-page folder on Economy Portable Pumping Unit, Type F. H. S.

Bulletin No. 404 describes the complete line of horizontal split case pumps, three types of double suction pumps, type "M", having capacities from 150-6,000 G.P.M. against medium heads, type "H" having the same capacities against high heads, and type "SM" having capacities from 10-225 G.P.M. against heads less than 100 feet. These are described and illustrated with engravings, accompanied by three pages of Tabular Recommendation.

The folder describes the Economy Portable Pumping Unit—the gasoline engine driven unit and compressor pump,— and is illustrated with halftones and diagrams.

New Ross Crusher Bulletin

A new bulletin has been issued by the Ross Power Equipment Co., of Indianapolis describing the large Ross line of gyratory roll and jaw crushers and pulverizers. Leaflet sent on request.

Taylor-Wharton Appoints T. K. Scott

Announcement is made by the Taylor-Wharton Iron and Steel Company of High Bridge, N. J., of the appointment of Thomas K. Scott as Mid-West sales manager, to be located at Denver, in charge of the sales-district of which Denver is headquarters. Mr. Scott has had a wide and profitable experience in mining.

Mr. Scott entered Columbia School of Mines and was graduated with the degree of Engineer of Mines. He was connected for some time with the Cumberland Ely Copper Company of Nevada, and also with the Inspiration Copper Company and the Miami Copper Company and was Chief Mining Engineer of Miami up to the time of his resignation last August. He is a member of the Miami Rotary Club.

T. K. Scott.

In his new connection with the Taylor-Wharton Iron and Steel Company, his mining experience will be of value.

Aldrich Pumps

Pump Data 50, dated June, 1924, has recently been issued by The Aldrich Pump Company of Allentown, Pa., it is a compilation of Engineering Tables, illustrated with halftones of Aldrich Pumps and diagrams.

Under *Pumps for Every Service*, are shown various pump units, for any drive, with all capacities and lifts. Under *Useful Information*, are listed weights and measures of water, crude oil, velocity head, static head, total dynamic head, suction lift, suction head, and viscosity.

Vulcan Gasoline Locomotive

Catalog No. 101, on Vulcan Gasoline Locomotives—Four Speed Worm Gear Drive—has recently been issued by the Vulcan Iron Works of Wilkes-Barre, Penn.

Over 50 years experience in designing and building locomotives is the enviable record claimed by this company, during which time they have kept pace with constantly changing conditions and requirements. Vulcan Gasoline Locomotives they say, are designed and built to conform to the four most important fundamentals of transportation:

1. Power—at the most economical speed as related to full economy, long life, and absence of vibration.
2. Dependability—based on approved details in Industrial Steam Locomotive Practice, recommended Standards of the Society of Automatic Engineers, and 50 years experience in solving haulage problems.
3. Accessibility—the result of experience, promoting ease of maintenance, encouraging careful adjustment, and marking possible efficient operation on account of more frequent inspections.
4. Economy — real economy depends on constant operation, where dependability is embodied in the moving parts which gives the greatest length of service, with minimum cost of maintenance, least attention, and no worry.

It contains many illustrations, tables of hauling capacities and speeds, and detailed descriptions.

P & H Appointments

The following changes and additions in the sales organization of Pawling & Harnischfeger Co. of Milwaukee, Wis:

N. P. Farrar, who until recently has been District Manager of the Philadelphia territory for this country, has been appointed Assistant Sales Manager. Mr. Farrar has had considerable experience with overhead electric traveling cranes, hoists, and gasoline powered excavators.

H. L. Mode, who has had ten years of experience in work with overhead electric traveling cranes, has been appointed a sales representative in the eastern territory with headquarters at New York and Philadelphia. Mr. Mode has also had seven years of experience in the motor department of the General Electric Co., and is well fitted to handle crane problems.

The Arkell Safety Trademark

The Arkell Safety Bag Company, 120 Broadway, New York, originators of Elastic Paper Bag and Barrel Linings, are now trade-marking all of their linings in red across the top, "ARKSAFE".

The experiments which lead to the invention of the Elastic Paper Lining more than twenty-five years ago, were made under the supervision of James Arkell, inventor of the paper flour and cement sacks.

Bay City's New Shovel

Announcement of a new installation is made by the Bay City Dredge Works of Bay City, Mich. This is their Model 16-B, ¾-yard gasoline shovel, equipped with a Climax engine. The excavator was made for the Crystal Sand Company of Bridgeton, N. J.

The Bay City Dredge Works state that they have made several new installations recently, but that their smaller machine, known to the trade as the One-Man Excavator, is shipped principally to small producers. The Crystal Sand Company purchased a Bay City ¾-yard shovel about a year ago and ordered their second Bay City last summer. This Company stated that the Bay City had demonstrated they could handle their material at a saving of over 50 per cent of what it cost with a steam shovel.

The accompanying illustration shows one of the new machines, a Bay City Model 16-B, convertible Crane-Elevator, operating with 40-ft. boom and clamshell bucket for the Paragon Plaster & Supply Company of Scranton, Pa.

Foote Bros. Establish Canadian Distribution Arrangement

Announcement is made by the Foote Bros. Gear & Machine Company of Chicago, of the recent completion of arrangements with the well-known Canadian firm of Darling Bros. of Canada. By this arrangement Darling Bros. will have the exclusive distribution of their IXL Gear Production and Speed Reducers throughout the Dominion of Canada.

The home office of Darling Bros. is in Montreal and they maintain branch offices in Windsor, Toronto, Winnipeg, Halifax, Ottawa, Vancouver and Quebec.

Ellicott Bulletin F-252

Bulletin F—252, recently issued by the Ellicott Machine Company of Baltimore, Md., is a four-page folder devoted to a description of the Heavy Duty Dredging Pumps manufactured by this company. The bulletin describes all outstanding details of construction and also lists former Bulletins:

Illustration of Special Spiral Rock Cutter—Form 164

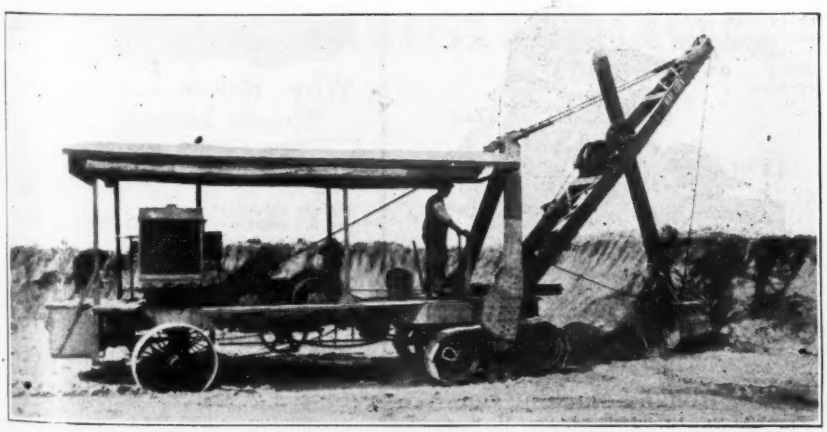
Bulletin A. B. Wood Patent Sewage & Dredging Pumps—Form B-1 and B-2

Standard Dredging Pumps and Accessories—Form 209

Standard Hydraulic Dredges—Form 233-A

Elevator Type Sand and Gravel Dredge—Form 196

Any of these bulletins may be had upon request.



The Bay City Model 16-B Shovel.

Our Inspection, Testing and Consultation Service Will Save You Money

Expert surveys and laboratory tests of Sand, Gravel, Limestone and other deposits. Inspection of new and second hand cars, locomotives, cranes, dredges, steam shovels, pumps, engines and all classes of pit, quarry and mill equipment.

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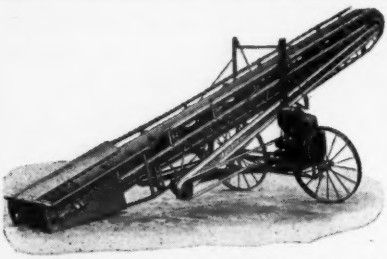


Especially intended for handling gravel, stone, sand, and similar materials

Austin Portable Conveyors

Made in two styles and all lengths between 16 and 68 ft. Furnished without power, or with gasolene or electric drive. Unmounted, or with 2 or 4 wheeled trucks as length requires. Write for special literature and prices.

Austin Manufacturing Co.
Chicago San Francisco New York

—New Holland—

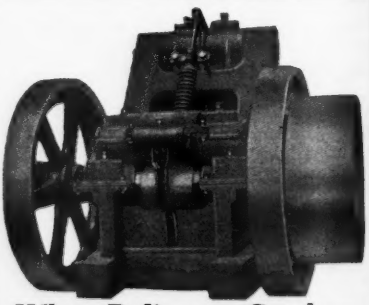
Swing Jaw Rock Crusher

The New Holland Swing Jaw Crusher is designed to crush all kinds of quarried rock into any size down to dust.

It is strongly made and designed for long, powerful stroke—giving great capacity. Made in three different sizes.

Write for our catalogue on crushers, elevators and screens.

New Holland Machine Co.
Franklin St., New Holland, Pa., U. S. A.



Why Reliance Crushers Should Interest You

Reliance Crushers are the result of years of experience. They are designed correctly to give maximum efficiency. They are of the best materials and rigidly inspected to give you that maximum efficiency even under adverse conditions.

Our crusher catalogue gives some very interesting facts. Write for your copy.

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